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Distribution, Abundance, and Life History of Bull Trout, and Habitat Conditions in the John Day River Basin

FY 2016 Report



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On the cover: *Headwaters of the North Fork John Day River in fall. Photograph by Paul Sankovich (FWS).*

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AND HABITAT CONDITIONS IN THE JOHN DAY RIVER BASIN

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Abstract

Abstract — The goal of the U.S. Fish and Wildlife Service’s studies in the John Day River Basin is to provide information that can be used to develop recovery actions for bull trout *Salvelinus confluentus*, listed as threatened under the Endangered Species Act. Herein, we summarize the existing state of our knowledge about the abundance, distribution, and life history characteristics of bull trout local populations in the North Fork John Day River, Middle Fork John Day River, and upper John Day River core areas, and report on the results of a bull trout habitat quality assessment that can be used to guide habitat restorations efforts.

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Introduction

Bull trout *Salvelinus confluentus* within the coterminous United States were listed as a threatened species under the Endangered Species Act (ESA) in 1999. The U.S. Fish and Wildlife Service (FWS) subsequently issued a Draft Recovery Plan (FWS 2002) that included a chapter for the John Day Recovery Unit (Chapter 9). This chapter was updated in 2004 (FWS 2004) and served as the guide for recovery actions in the John Day River Basin until the final recovery plan was issued in 2015 (FWS 2015). The ultimate goal of the FWS' bull trout recovery strategy is to "manage threats and ensure sufficient distribution and abundance to improve the status of bull trout throughout their extant range in the coterminous United States so that protection under the ESA is no longer necessary" (FWS 2015). Among the requirements to meet this goal is information on the abundance, distribution, and life history characteristics of the various bull trout local populations, as is information on the condition of habitats bull trout utilize to complete their life cycle.

In the John Day River Basin, there is currently no system-wide abundance monitoring program for bull trout. Oregon Department of Fish and Wildlife (ODFW) biologists count redds in a few selected index areas, sometimes not annually. Short-term studies have been conducted that provided information on abundance for a small portion of the basin's bull trout populations (Hemmingsen 2001a, 2001b, 2001c; Budy et al. 2004, 2005, 2006; Sankovich and Anglin 2014), and for the entire basin but not individual populations (Jacobs et al. 2009). There also have been no system-wide surveys to determine how many local bull trout population exist, in which streams they occur, and where the spawning and early rearing areas are. It is suspected, however, that the number and locations of existing bull trout populations are fairly well known due to a host of sampling activities and assessments that have occurred through the years (Ratliff and Howell 1992; Buchanan et al. 1997; ODFW 2005).

Bull trout in the John Day River Basin are known to exhibit two different life history strategies, resident and migratory. Stream-resident bull trout complete their entire life cycle in the tributary streams where they spawn and rear. Subadult bull trout (immature, migratory individuals that are usually <300 mm fork length [FL] in northeastern Oregon streams) exit their natal tributary at ages 1 - 3 (Pratt 1992; Downs 2006; Homel and Budy 2008; Howell et al. 2016). For fluvial subadults, this initial migration can occur throughout the year, but there are generally major and minor peaks in spring and fall, respectively (e.g., Howell et al. 2016). Fluvial subadults generally reside in a larger river for several years before returning to their natal stream to spawn as adults at age 4 - 7 (Rieman and McIntyre 1993; Mogen and Keading 2005; Muhlfeld and Morotz 2005). Migratory adult bull trout overwinter in larger rivers and return upstream to spawning grounds from April through September (Pratt 1992; Swanberg 1997; Starcevich et al 2012; Howell et al. 2016). They return downstream following the spawning period in fall (Starcevich et al 2010, 2012; Howell et al. 2016). Although both resident and migratory life history forms are known to be present in the John Day River Basin and documents exist identifying (based on empirical data and professional judgment) which life history forms occur in each local population (e.g., FWS 2002; ODFW 2005) questions still remain whether resident or migratory forms or both occur in some local populations due to a lack of rigorous investigation. In addition, although the migratory patterns and seasonal distribution of subadult and adult bull trout have been described to some extent (Hemmingsen et. al. 2001a, 2001b,

2001c, 2001d; Sankovich and Anglin 2014), they remain largely unknown for most of the local populations.

Habitat restoration will be a key component of bull trout recovery efforts in the John Day River Basin (FWS 2015). A first step in those efforts will be to identify and prioritize stream reaches requiring restoration in the three core areas (upper mainstem John Day River [JDR], North Fork John Day River [NFJDR], and Middle Fork John Day River [MFJDR]). The NFJDR, MFJDR, and JDR are long (180, 114, and 457 km, respectively), so it is not surprising data have not been collected that would allow for a fine-scale habitat assessment along the full length of those streams. There have been at least two macro-level habitat assessments, based primarily on the professional judgment of local experts, that identified and prioritized stream reaches requiring restoration in the John Day River Basin (Columbia-Blue Mountain Resource Conservation and Development Area 2005; Confederated tribes of the Warm Springs Reservation of Oregon 2014). The FWS recently developed a model to assess bull trout habitat quality at the reach scale for two life stages (adult and subadult) and eight strategies or activities exhibited by those life stages during each month of the year (Schaller et al. 2014). The model relies on existing data, information obtained from topographic maps and aerial photos, and GIS applications. Utilizing it to assess bull trout habitat quality in the NFJDR, MFJDR, and upper JDR could further inform habitat restoration activities in the John Day River Basin.

In this document, we summarize the current state of our knowledge of where bull trout local populations occur in the three core areas in the John Day River Basin; where bull trout “patches” (contiguous areas containing the spawning and early rearing habitat used by local bull trout population [FWS 2008]) are located; and the abundance, distribution, and life history characteristics of bull trout from each of the local populations. We then report on the methods and results of a bull trout habitat quality assessment of the NFJDR, MFJDR, and JDR upstream from its confluence with the NFJDR and discuss the implications of that assessment relative to the implementation of recovery actions. For details on how the bull trout patches were identified, readers are referred to FWS (2008).

North Fork John Day River Core Area

Number and locations of bull trout populations and patches

The John Day River Recovery Unit Team identified six bull trout local populations in the NFJDR core area: 1) upper North Fork John Day River (Crawfish, Baldy, Cunningham, Trail, Onion, and Crane Creeks and the North Fork John Day River upstream from Granite Creek), 2) upper Granite Creek (Bull Run, Deep, Boundary, Boulder, and upper Granite creeks), 3) Clear, Lightning, and Salmon creeks upstream from the Pete Mann ditch, 4) Clear and Lightning creeks below the Pete Mann ditch, 5) Desolation Creek (South Fork Desolation Creek below a barrier falls, and North Fork Desolation Creek), and 6) upper South Fork Desolation Creek upstream from the barrier falls (FWS 2002). Using a minimum catchment area of 400 ha and minimum elevation of 1700 m (the estimated elevation at which maximum summer stream is <16°C) the FWS identified seventeen bull trout patches in the NFJDR core area (Figure 1; Appendix A, Table 1). Bull trout are known to occupy eight of those patches: North Fork John

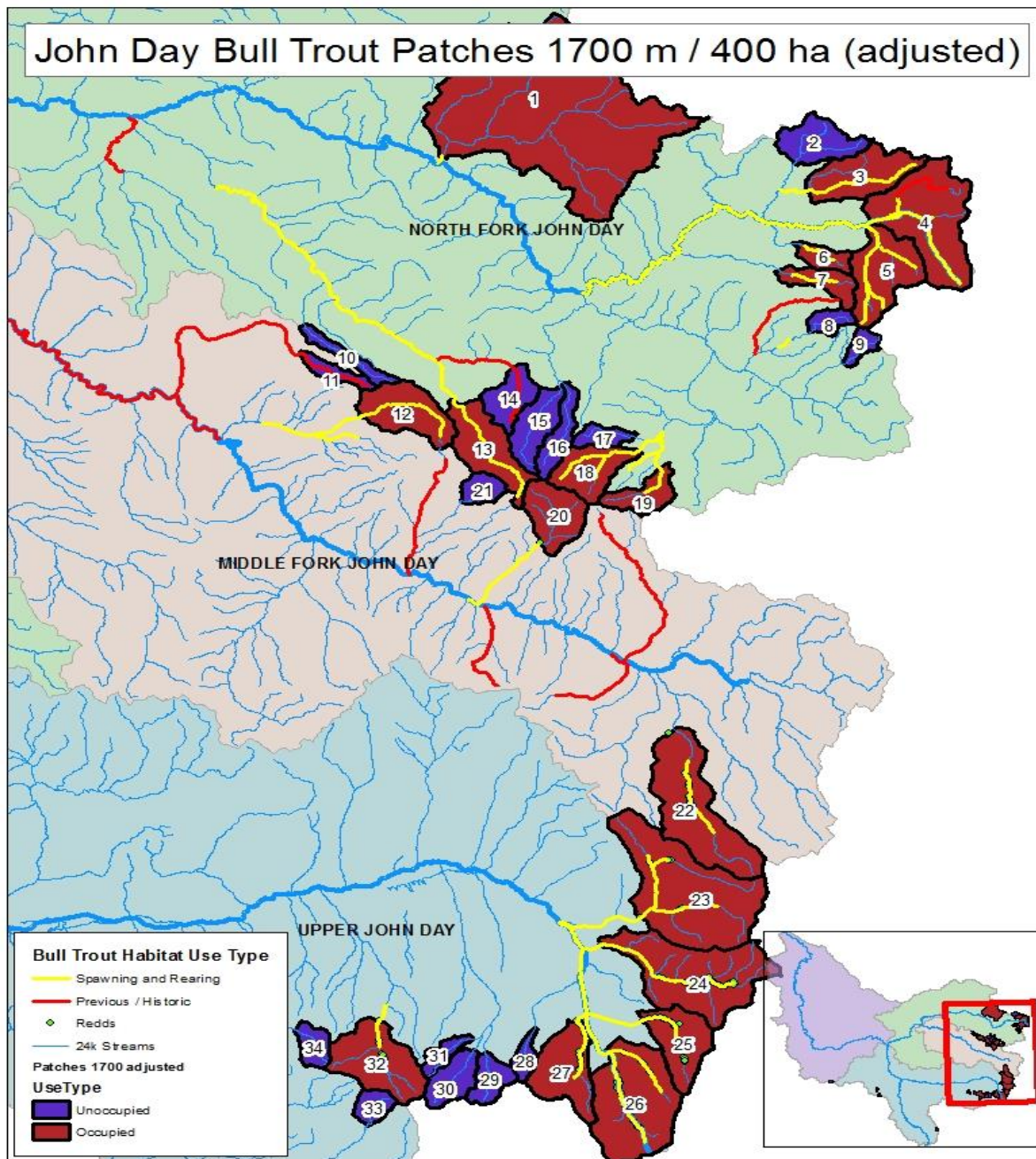


Figure 1. Occupied and (suspected) unoccupied bull trout patches in the North Fork John Day, Middle Fork John Day, and upper John Day River core areas. In cases where the lower limit of bull trout spawning and early was known and differed from the modeled downstream boundary of a patch, the downstream boundary was adjusted to coincide with the known lower limit. The names and areas of the patches are given in Appendix A, Table 1. The locations of patch numbers 35-40 are shown in the insert (outside the red box) but not in the magnified image.

Day River, and South Fork Trail, Baldy, Onion, Crane, South Fork Desolation, Clear, and Lightning creeks. These patches coincide closely to the local populations identified by the

recovery team. Two bull trout approximately 152 and 203 mm in length were recently captured in Junkens Creek (T. Wiley, ODFW, personal communication), which was identified as a bull trout patch in the patch analysis, but that stream has not been sampled rigorously to establish whether it actually supports a local population.

Life histories and migratory patterns of local bull trout populations

Resident bull trout are present in each of the local populations in the NFJDR core area. Recent observations of migratory adult-sized bull trout have occurred only in the NFJDR and Baldy Creek (Sankovich and Anglin 2014), South Fork Desolation Creek (I. Tattam, Oregon Department of Fish and Wildlife [ODFW], personal communication), and South Fork Trail Creek (R. Al-Chokhachy, USGS, personal communication). One subadult-sized bull trout radio-tagged in the John Day River downstream from the town of Spray migrated upstream into the NFJDR and ultimately into Granite Creek in 2000 (Hemmins et al. 2001d). A subadult-sized bull trout was also observed recently in lower Clear Creek (A. Johnson, U.S. Forest Service [USFS], personal communication).

The migrations and seasonal distribution of adult and subadult bull trout have not been studied extensively in the NFJDR core area. In 2005-2007, the FWS radio-tagged three migratory adult-sized bull trout (>300 mm FL) and three migratory adult-sized apparent brook trout *Salvelinus fontinalis* x bull trout hybrids captured by angling in the upper 18 km of the NFJDR or in a weir trap in the NFJDR just below the mouth of Baldy Creek (at river kilometer [rkm] 105). All of these fish migrated upstream onto the spawning grounds in the NFJDR or Baldy Creek in summer (Sankovich and Anglin 2014). The tracking data for all of the bull trout and two of the apparent hybrids were limited due to mortality or tag shedding or failure. Some of the bull trout began migrating downstream after the spawning period, and two of the apparent hybrids also returned downstream in the fall (Sankovich and Anglin 2014). One of the apparent hybrids, the only fish for which the FWS was able to describe an annual pattern of migration, migrated downstream 72 km in fall, over-wintered at that site, began migrating upstream in spring, and reached the spawning grounds in summer. Its annual pattern of migration was typical of those of migratory adult bull trout in relatively undisturbed stream systems (e.g., Starcevich et al. 2010, 2012).

In fall 2009, the FWS radio-tagged four bull trout captured in a rotary screw trap at rkm 97 on the NFJDR. All but perhaps one, which was 300 mm FL, were subadult sized. These fish continued to migrate downstream but likely remained in the NFJDR during the lives of their 96-d tags (Sankovich and Anglin 2014). As noted above, a subadult bull trout captured and radio-tagged on the JDR during spring 2000 migrated up the NFJDR and into Granite Creek in summer (Hemmins et al. 2001d); thus, there is evidence suggesting some bull trout from the NFJDR core area overwinter in the JDR.

Abundance of bull trout in local populations

Abundance data are limited for bull trout local populations in the NFJD core area. Baldy Creek is the only stream where redd counts have been conducted somewhat regularly in recent

Table 1. Bull trout redd counts in ODFW index reaches in streams in the John Day Basin in 2001-2015.

Year	Number of redds			
	Baldy Cr	Big Cr	Call Cr	N.F. Reynolds Cr
2001	2	23	12	5
2002	3	13	3	3
2003	3	6	6	4
2004	3	1	13	2
2005	7	2	5	0
2006	3	1	0	5
2007	0	0	-	4
2008	2	-	-	-
2009	-	0	0	1
2010	-	-	0	0
2011	-	-	-	-
2012	5	0	2	1
2013	2	0	1	1
2014	0	-	-	-
2015	-	-	0	1

years. Since 2001, redd counts in an ODFW index reach in Baldy Creek have ranged from 0 to 7 in years when the counts have occurred (Table 1). In 2005-2008, the FWS conducted spawning ground surveys in the NFJDR and more extensive surveys (in time and space) in Baldy Creek. The survey reach in the NFJDR encompassed the entire spawning area, and the survey reach in Baldy Creek included its lower 5 km. The extent of the spawning area in Baldy Creek has never been fully defined but is known to extend upstream of the reach the FWS surveyed. The FWS counted 6 to 17 redds in the NFJDR and 0 to 10 redds in Baldy Creek each year (Sankovich and Anglin 2014). Based on the size of the redds and the substrate in which they were constructed, the FWS estimated migratory females made 0 to 9 redds in the NFJDR and 0 to 8 redds in Baldy Creek each year. The FWS also surveyed approximately 4 km of South Fork Desolation Creek (from Forest Road 45 upstream to a potential passage barrier) in 2006 and 2007 and found no redds in either year.

The weir trap the FWS operated in the NFJDR (noted above) captured three migratory adult-sized bull trout and three apparent brook trout x bull trout hybrids in 2006 and no fish in 2007. The weir may not have been installed early enough in 2006 to capture the entire run of migratory adults; however, it was in 2007, and the results from both years indicate migratory adult bull trout abundance in the upper NFJDR and Baldy Creek had fallen to an exceedingly low level.

Researchers from Utah State University conducted mark-resight surveys in the NFJDR and Baldy Creek in 2005 and 2006. The lower and upper bounds of the 95% C.I.s for the abundance estimates of bull trout >120 mm ranged from 274 to 2052 in the NFJDR and from

545 to 2509 in Baldy Creek (Budy et al 2006, 2007). The >120 mm size class could include resident juveniles and adults, and migratory juveniles and adults.

In 2002-2004, ODFW estimated there were from 39 (SE = 13) to 145 (SE = 45) redds in the entire NFJDR core area (S. Starcevich, ODFW, personal communication). The estimates were obtained using a probabilistic sampling design (EMAP [Stevens 1994; Stevens and Olsen 2004]) within a sampling frame that included all wadable stream reaches containing known and potential bull trout spawning habitat.

Overall, the available information indicates the abundance of bull trout in the NFJDR and Baldy and South Fork Desolation creeks is low. No abundance data are available for the remaining bull trout local populations in the NFJDR core area, and up-to-date information on trends in abundance is largely lacking for all of the populations.

Middle Fork John Day River Core Area

Number and locations of bull trout populations and patches

The John Day River Recovery Unit Team identified three bull trout local populations in the MFJDR core area: 1) Clear Creek, 2) Granite Boulder Creek, and 3) Big Creek (FWS 2002). The FWS identified five bull trout patches in the MFJDR core area (Figure 1; Appendix A, Table 1). Bull trout are known to occupy three of those patches (Big, Granite Boulder, and Clear creeks), which are located in the three streams the recovery team identified as supporting bull trout local populations. In 2007, juvenile bull trout were observed during a culvert removal project in Butte Creek (FWS, unpublished report), which was not identified as a patch and has not been rigorously surveyed to determine if it supports a bull trout local population.

Life histories and migratory patterns of local bull trout populations

Resident bull trout are present in each of the local populations in the MFJDR core area. Migratory bull trout are infrequently captured in a rotary screw at river rkm 24 on the Middle Fork John Day River (Wilson et al. 2007; I. Tattam, ODFW, personal communication); thus, they are present in the core area. However, it is uncertain from which of the local population(s) they originate. Four bull trout greater than 400 mm FL were sampled in Big Creek and Granite Boulder Creek during population surveys in those streams in 1999 (ODFW, unpublished report), suggesting there was a fluvial component to the populations in those streams at that time. In addition, two bull trout in the 300-450 mm size class were observed during spawning ground surveys in Big Creek and its tributary Deadwood Creek in 2002 and 2003, and some relatively large redds were observed in Clear Creek in 2005 (S. Starcevich, ODFW, personal communication).

Little is known about the migratory patterns of bull trout from the MFJDR core area beyond what can be gleaned from the sparse information collected at the rotary screw trap. The low abundance of migratory bull trout in the MFJDR core area makes studying their migratory patterns difficult, if not impossible.

Abundance of bull trout in local populations

The abundance of bull trout in the MFJDR core area appears to be low. In 1999, ODFW biologists estimated there were 1950 (95% CI: 882 - 3018), 640 (122 - 1158), and 368 (8 - 728) age 1 or older bull trout in Big, Clear, and Granite Boulder creeks, respectively (ODFW, unpublished report). Since 2001, redd counts in Big Creek have ranged from 0 to 23 (Table 1).

In 2002-2004, ODFW estimated there were from 42 (SE = 29) to 192 (SE = 99) redds in the entire MFJDR core area (S. Starceovich, ODFW, personal communication). The estimates were obtained using the EMAP protocol. In 2005, ODFW conducted redd counts throughout the entire sampling frame used for the EMAP surveys and counted 25 redds (S. Starceovich, ODFW, personal communication).

Up-to-date information on population size and trend is lacking for all of the bull trout local populations in the MFJDR core area. If the redd counts in Big Creek (Table 1), which were conducted in an index reach, accurately reflected the status of the bull trout local population in Big Creek, that population was declining to exceedingly low levels from 2001 to 2013.

Upper John Day River Core Area

Number and locations of bull trout populations and patches

The John Day River Recovery Unit Team identified two bull trout local populations in the upper JDR core area: 1) upper John Day River, which includes Deardorff, Reynolds, Rail, Roberts, and Call creeks, and 2) Indian Creek. The FWS identified eighteen bull trout patches in the JDR core area (Figure 1; Appendix A, Table 1). These patches include all of the streams in which the recovery team identified local populations, in addition to Graham, Slide, Strawberry, Onion, Middle Fork Canyon, Pine, Norton Fork, and Dean creeks in the upper JDR (upstream from the town of John Day), and Rock, Baldy, Bridge, and Lonesome creeks in the lower JDR (downstream from John Day). Bull trout local populations are presently known to exist only in the streams identified by the recovery team. A single, subadult-sized bull trout was recently observed in Graham Creek (T. Unterwegner, ODFW retired, personal communication), but there is no evidence of a local population existing there.

Life histories and migratory patterns of local bull trout populations

Resident bull trout are present in each of the local populations in the upper JDR core area. Migratory bull trout are present in all but perhaps the Indian Creek local population, which is believed to be comprised only of resident individuals because Indian Creek is seasonally de-watered in its lower reaches.

ODFW studied the migrations of bull trout in the upper John Day River and Call, Deardorff, Reynolds, and Roberts creeks in 1997-2000 (Hemmingsen et al. 2001a, 2001b, 2001c, 200d). Up- and downstream migrant weir traps were operated in the tributaries and in the John Day River upstream from Call Creek. A screw trap was operated in the John Day River just below Deardorff Creek in 1997 and 1998 and Reynolds Creek in 1999. Bull trout ≥ 150 mm FL

captured in the traps were PIT-tagged. Forty-seven fish ranging from 160 to 560 mm FL were also outfitted with radio tags. Bull trout moved past the downstream trap sites (including the screw trap) in all months of sampling (April - October). Most downstream migrants captured before mid-August were < 200 mm FL. Abundance of these smaller migrants peaked in spring and early summer. Larger, migratory adult-sized fish appeared in greater numbers in September, presumably after spawning. At the upstream traps, bull trout ranging from 180 mm to 560 mm FL were captured from April through September, with peak abundance occurring in July. The telemetry data indicated the lower limit of the bull trout distribution in the John Day River in summer and winter was at rkm 421 (the town of Prairie City) and rkm 400 (the town of John Day), respectively. However, since that study, three bull trout have been captured in a screw trap at rkm 326, two in November 2003 and one in February 2004. (I. Tattam, ODFW, personal communication). Two of these fish were measured and were 280 and 300 mm FL.

Abundance of bull trout in local populations

Abundance data, particularly collected in recent years, are limited for bull trout local populations in the upper JDR core area. Redd counts in ODFW index reaches in Call Creek and North Fork Reynolds Creek ranged from 0 to 13 and 0 to 5, respectively, in 2001-2015 (Table 1), suggesting the populations in those streams are small. ODFW estimated there were from 103 (SE = 70) to 204 (SE = 89) redds in the entire upper JDR core area in 2002-2004 (S. Starcevich, ODFW, personal communication). The estimates were obtained using the EMAP protocol. In 2005, ODFW conducted redd counts throughout the entire sampling frame used for the EMAP surveys and counted 129 redds (S. Starcevich, ODFW, personal communication).

Although ODFW operated upstream and downstream migrant traps in the John Day River and Call, Roberts, Deardorff, and Reynolds in 1997-1999 (Hemmingsen et al. 2001a, 2001b, 2001c), the data collected at the traps are limited in their usefulness for estimating abundance because the traps in the tributaries and upper main stem were not fished consistently during important parts of the year due to high flows, and the screw trap data were not adjusted for trap efficiency. Still, those data suggest the local populations in the upper JDRS were not large in 1997-1999 (Table 2)

Information on trends in abundance is lacking for all but the Call Creek and Reynolds Creek local populations. Based on redd counts in index areas, it appears those populations have generally been declining since 2001 (Table 1).

Bull Trout Habitat Quality Assessment

Methods

To evaluate habitat conditions, we conducted a bull trout habitat quality assessment following the methods described by Schaller et al. (2014). Briefly summarized, we divided the North Fork, Middle Fork, and upper John Day (upstream from the mouth of the North Fork) rivers into reaches containing fairly uniform habitat conditions that differed from habitat conditions in adjacent reaches (Figures 2,3 and 4; Appendix B, Tables 1,2, and 3). We identified

Table 2. Number of bull trout captured in downstream and upstream traps in the John Day River and Call, Roberts, Deardorff, and Reynolds creeks in 1997-1999. In the John Day River, up- and downstream migrant weir traps were operated in the upper main stem (JD1) and a downstream migrant screw trap was operated below Deardorff Creek in 1997 and 1998 and Reynolds Creek in 1999 (JD2).

Trap	Year	Stream					
		JD1	JD2	Call	Roberts	Deardorff	Reynolds
downstream	1997	37	158	28	10	22	
	1998	27	158	86	35	11	
	1999	11	61	94	32		36
upstream	1998	5		34	8	9	
	1999	5		17	7		9

the reaches based on channel modifications, land uses, stream gradient, elevation, and the location of irrigation dams and withdrawals and major tributaries. Habitat quality was assessed in relation to two life stages (adult and subadult) and eight strategies or activities exhibited by those life stages: adult spawning; juvenile rearing, foraging and growth; fluvial adult upstream migration; adult foraging and maintenance; fluvial adult downstream migration; fluvial subadult downstream migration; fluvial subadult upstream migration; and fluvial subadult rearing, foraging, and growth. A model was developed to calculate a monthly habitat quality score (HQS) for each stream reach and life stage, strategy, or action. The model was based on eleven

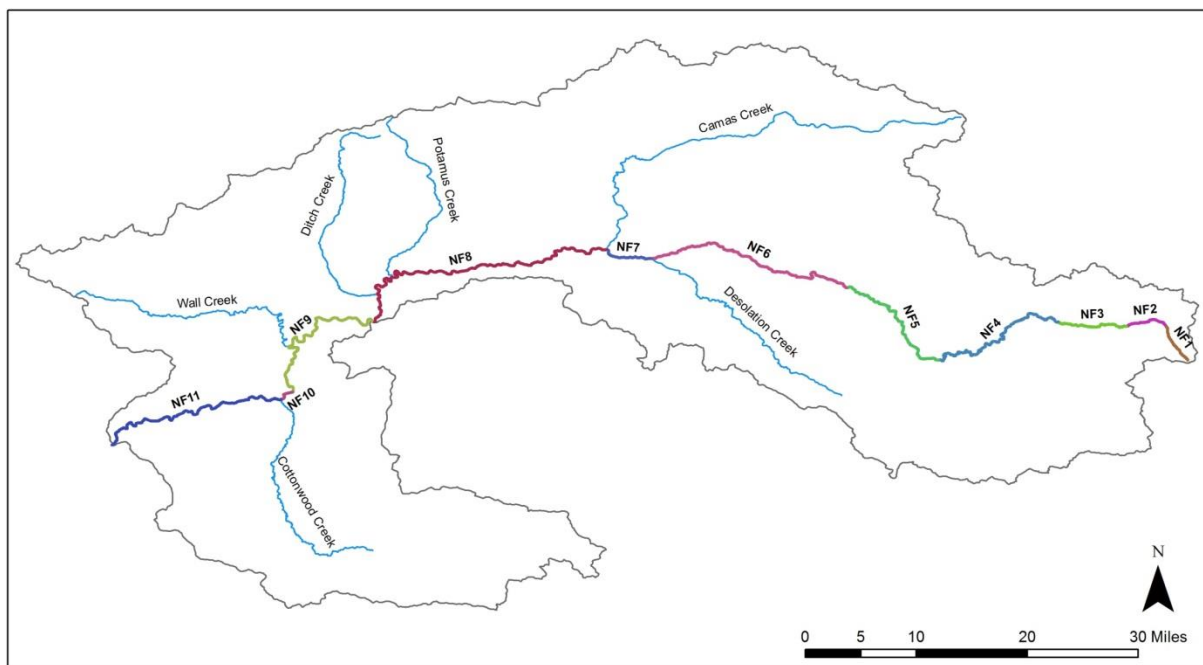


Figure 2. Reach locations in the North Fork John Day River core area.

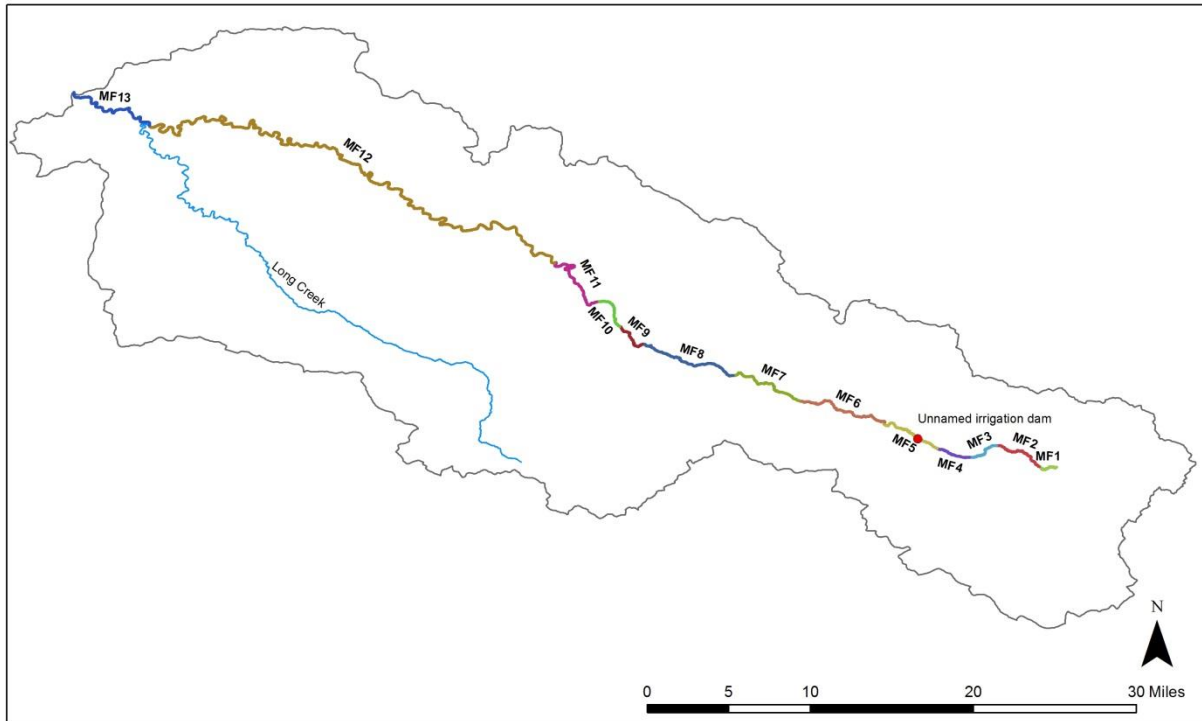


Figure 3. Reach locations in the Middle Fork John Day River core area.

habitat variables: surface flow, groundwater, water temperature, passage impediments, channel modification, riparian zone, stream gradient, elevation, land use, geology and sinuosity. These habitat variables were assigned a rating factor for each month and reach, and the rating factors were adjusted by a weighting factor to reflect each variable's relative importance. The weighting factors were developed using an Analytical Hierarchal Process method adapted from Saaty (2008). Each HQS was calculated as:

$$HQS = (HV_1 \times WF_1) + (HV_2 \times WF_2) + \dots + (HV_{11} \times WF_{11}),$$

where HV = habitat variable and WF = weighting factor. We rated habitat quality as poor, low, fair, good, or high if the habitat quality score was ≤ 1.8 , >1.8 and ≤ 2.6 , >2.6 and ≤ 3.4 , >3.4 and ≤ 4.2 , or >4.2 and ≤ 5 , respectively. The lowest habitat quality score possible was 1 and the highest was 5; thus, the five ratings each spanned 0.8 scoring units.

Because stream temperature data were too sparse both temporally and spatially to characterize stream temperatures in the NFJDR and upper JDR, we had to estimate mean monthly 7DADM temperatures (the temperature metric utilized in our model). We did this by first identifying the estimated August mean temperature at the approximate mid-point of each reach using the USFS' Interactive Temperature Scenario Viewer (<https://www.sciencebase.gov/gisviewer/NorWeST/>). We then converted the August mean temperature estimates to estimates of August mean 7DAD

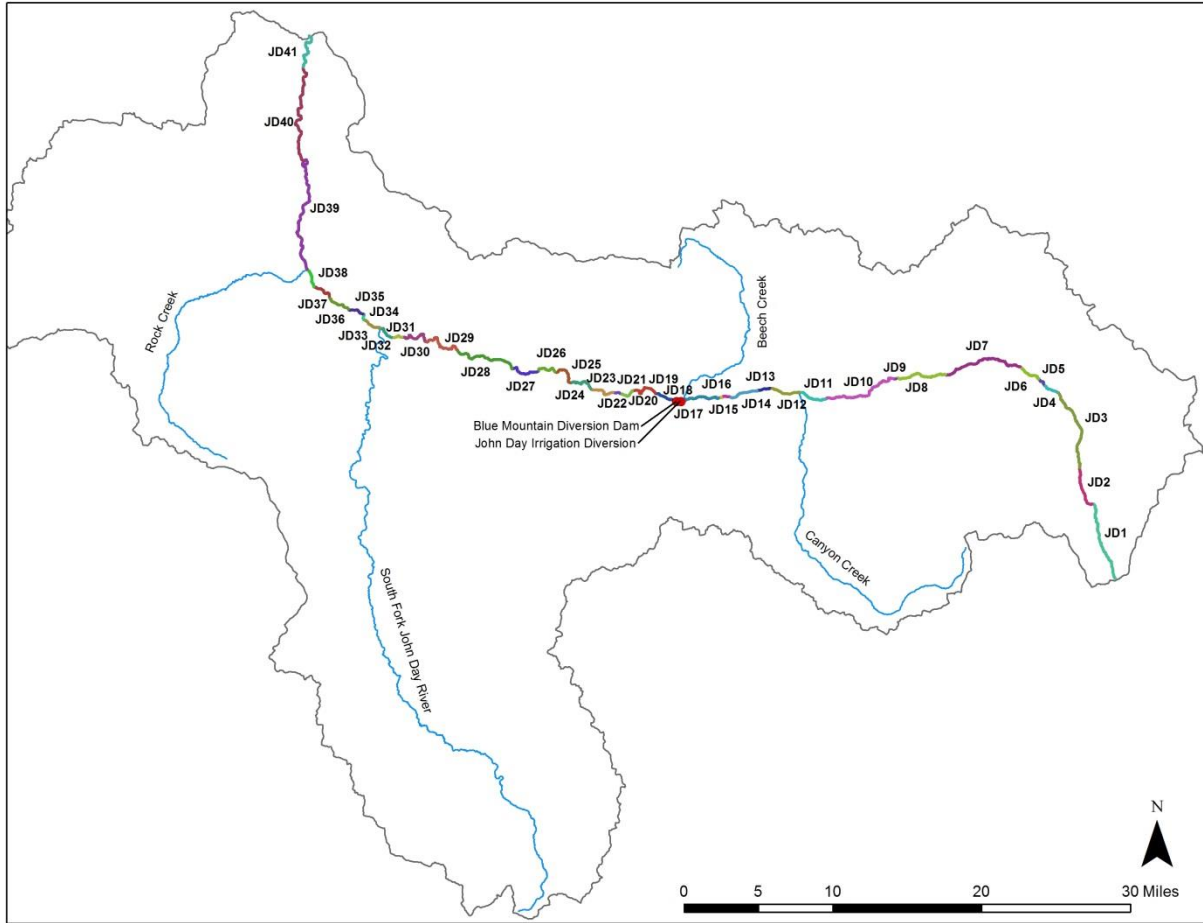


Figure 4. Reach locations in the upper John Day River core area.

maximum temperature using the equation

$$y = 1.39x + 0.095$$

where y = August mean 7DADM temperature and x = August mean temperature. This equation was based on the correlation ($r^2 = 0.89$) between the two temperature metrics for stream temperatures measured at approximately 500 sites (D. Isak, USFS, personal communication). The Interactive Temperature Scenario View provides estimates only of August mean temperature. Thus, we assumed stream temperatures during the colder months of the year were high quality (rating factor = 5) and estimated the monthly mean 7DADM temperatures for June, July, September, and October based on the differences between the August mean 7DAD temperature and the mean 7DADM temperatures for each of those months over a ten year period (2004 – 2013) in the nearby Umatilla River Basin. In that basin, the mean 7DADM temperature in August was 1.4°C (SD = 2.0) warmer than that in June, 1.0°C (SD = 1.3) cooler than that in July, 2.7°C (SD = 1.7) warmer than that in September, and 7.2°C (SD = 2.2) warmer than that in October.

Groundwater data were also sparse for all of the rivers, so we set the monthly rating factor for all reaches at 3 (fair quality). In the upper JDR, surface flow data were available at only two relevant gauging stations, which was insufficient for rating stream flow in the thirty-eight reaches that had irrigation withdrawals or were downstream from reaches with irrigation withdrawals (Appendix B, Table 3). For those reaches, we set the monthly rating factor for surface flow at 3 during the irrigation season (April – October) and 5 (high quality) during the remainder of the year. Surface flow in the reaches upstream from the section of the upper JDR containing irrigation withdrawals was set at 5 throughout the year.

In the upper JDR, push up dams and lay flat stanchion dams are used to divert stream flow for irrigation. The physical structure of push up dams can be altered within the irrigation season (e.g., can transition from not blocking the entire stream channel to blocking the entire stream channel) and can differ among years. Lay flat stanchion dams are designed to allow fish passage, but they may not at lower flows, particularly if not maintained properly. Because of the uncertainty in whether push up and lay flat stanchion dams were passage impediments during a particular month, we gave each reach containing either of the two types of dams a rating factor of 3 (fair) passage conditions during the months of August (the onset of low flows) through November (when the absence of irrigation and onset of fall rains increase stream flows and the push up dams potentially would be submerged or breached). During the remaining months of the year, we gave these reaches a rating factor of 5 (no passage impediments), as we did for the remaining reaches for all months of the year.

Results

Because surface flow and stream temperature are the most heavily weighted habitat variables in the habitat assessment model, accounting for 22% and 26% of an HQSs, respectively, the model can provide misleading results in stream reaches where surface flows are natural, or nearly so, yet stream temperatures are unsuitable for bull trout. This was the case for the NFJDR and MFJDR, and to a lesser extent for the more heavily diverted upper JDR. For example, for adult spawning in the NFJDR, the model results indicated habitat quality is fair or better throughout the year (Appendix C, Table 1), whereas if the HQSs were based solely on stream temperature, habitat quality for the most part would be rated as low or poor from June through November (Appendix C, Table 2). Thus, while the model results allow for comparisons to be made in a relative sense between habitat conditions in different stream reaches during each month of the year, the habitat conditions may be poorer than reported herein.

North Fork John Day River Core Area

Adult spawning.--Modeled scores indicated that during the spawning period (mid-August through October) high quality spawning habitat is present only NF1 in October (Appendix C, Table 1). Spawning habitat was rated as good in and upstream from NF4 in August, September, and October (excluding NF1 in October). All of the remaining reaches were rated as having fair quality spawning habitat during the spawning period.

Juvenile rearing, foraging and growth.--Within the juvenile bull trout rearing area in the NFJDR (NF1 through NF3) the quality of juvenile rearing, foraging, and growth habitat was

rated good during summer and high or good throughout the remainder of the year (Appendix C, Table 3). Habitat quality in the river downstream from NF3 was rated as good in the summer and high or good the remainder of the year.

Fluvial adult upstream migration.--The quality of habitat for fluvial adult upstream migration generally was rated as high or good throughout the year upstream from NF1 (Appendix C, Table 4). Habitat quality generally was rated as high or good during the period of fluvial adult upstream migration (spring and summer) throughout the river. Habitat quality was rated as fair in NF1 in July and August.

Adult foraging and maintenance.--The quality of habitat for adult foraging and maintenance was rated as high or good upstream from NF9 throughout the year (Appendix C, Table 5). In and downstream from NF9 habitat quality was rated as high or good from November to May and as good or fair from June through October.

Fluvial adult downstream migration.--The quality of habitat for fluvial adult downstream migration generally was rated as high or good during the period of adult downstream migration (fall and early winter)(Appendix C, Table 6). Habitat quality was rated as good or fair downstream from NF4 in summer.

Fluvial subadult downstream migration.--The quality of habitat for fluvial subadult downstream migration was rated as high or good throughout the year upstream from NF10 (Appendix C, Table 7). In and downstream from NF10, habitat quality was rated as good or fair from June through September.

Fluvial subadult upstream migration.--The quality of habitat for fluvial subadult upstream migration was rated as high or good throughout the year upstream from NF11 (Appendix C, Table 8). In NF11, habitat quality was rated fair in June, July, and August and high or good the remainder of the year.

Fluvial subadult rearing, foraging, and growth.--The quality of habitat for fluvial subadult rearing, foraging, and growth was rated as high or good throughout the year upstream from NF8 (Appendix C, Table 9). Habitat quality was rated as good or fair in and downstream from NF8 from June through October and as high or good the remainder of the year.

Middle Fork John Day River Core Area

Adult spawning.--Modeled scores indicated that during the spawning period (mid-August through October) the quality of adult spawning habitat is good or fair (Appendix D, Table 1). Spawning habitat was generally rated as high or good from November through May and good or fair in June and July throughout the MFJDR.

Juvenile rearing, foraging and growth.--From September through May the quality of juvenile rearing, foraging, and growth habitat generally was rated as high or good throughout the MFJDR (Appendix D, Table 2). In June, July, and it was generally rated as fair.

Fluvial adult upstream migration.--The quality of habitat for fluvial adult upstream migration generally was rated as high or good throughout the year (Appendix D, Table 3). Habitat quality was rated as fair in MF3, 4, 5 and 10 in August and MF10 in July.

Adult foraging and maintenance.--The quality of habitat for adult foraging and maintenance generally was rated as high or good from June through September (Appendix D, Table 4). It was rated as good or fair in July and August.

Fluvial adult downstream migration.--The quality of habitat for fluvial adult downstream migration generally was rated as high or good from September through June (Appendix D, Table 5). Habitat quality was rated as good or fair in July and August.

Fluvial subadult downstream migration.--The quality of habitat for fluvial subadult downstream migration generally was rated as high or good from September through June (Appendix D, Table 6). Habitat quality was rated as good or fair in July and August.

Fluvial subadult upstream migration.--The quality of habitat for fluvial subadult upstream migration was rated as high or good from September through June (Appendix D, Table 7). Habitat quality was rated good or fair in July and August.

Fluvial subadult rearing, foraging, and growth.--The quality of habitat for fluvial subadult rearing, foraging, and growth generally was rated as high or good from September through June (Appendix D, Table 8). Habitat quality was rated as fair in August throughout the MFJDR and in January through March, July through September, and November in MF10.

Upper John Day River Core Area

Adult spawning.--Modeled scores indicated that during the spawning period (mid-August through October) the quality of adult spawning habitat is good in JD1 and JD2 and fair or low in the remaining reaches (Appendix E, Table 1). Spawning habitat was rated as high or good from November through May throughout the JDR.

Juvenile rearing, foraging and growth.--From November through May the quality of the quality of juvenile rearing, foraging, and growth habitat generally was rated as high or good throughout the MFJDR (Appendix E, Table 2). In June, July, and it was generally rated as fair.

Fluvial adult upstream migration.--The quality of habitat for fluvial adult upstream migration was rated as high or good from November through May (Appendix E, Table 3). In June through October, habitat quality was rated as high or good from JD3 upstream, and primarily as fair from JD5 downstream. In JD22 habitat for fluvial adult upstream migration was rated as fair in July and August.

Adult foraging and maintenance.--The quality of habitat for adult foraging and maintenance generally was rated as high or good from November through May throughout the upper JDR (Appendix E, Table 4). It also generally was rated as high or good from JD3 upstream throughout the year. Downstream from JD3, the quality of habitat for adult foraging

and maintenance primarily was rated as fair in June, September, and October, fair or low in July, and low in August.

Fluvial adult downstream migration.--The quality of habit for fluvial adult downstream migration generally was rated as high or good from November through May throughout the upper JDR (Appendix E, Table 5). It also generally was rated as high or good from JD3 upstream throughout the year. Downstream from JD3, habitat quality for the most part was rated as good or fair in September, October, and June, and as fair or low in July and August.

Fluvial subadult downstream migration.--The quality of habit for subadult downstream migration generally was rated as high or good from November through May throughout the upper JDR (Appendix E, Table 5). It also generally was rated as high or good from JD3 upstream throughout the year. Downstream from JD3, habitat quality for the most part was rated as good or fair in September, October, and June, and as fair or low in July and August.

Fluvial subadult upstream migration.--The quality of habitat for fluvial subadult upstream migration generally was rated as high or good from November through May throughout the upper JDR (Appendix E, Table 7). It was rated as high or good from JD3 upstream throughout the year. Downstream from JD3, habitat quality generally was rated as fair or low in June through October.

Fluvial subadult rearing, foraging, and growth.-- The quality of habitat for fluvial subadult upstream migration generally was rated as high or good from November through May throughout the upper JDR (Appendix E, Table 7). It was rated as high or good from JD3 upstream throughout the year. Downstream from JD3, habitat quality generally was rated as fair or low in June through October.

Discussion, Conclusions and Management Implications

For the MFJDR core area, the number and locations of bull trout patches closely approximated what is believed to be the actual number and locations of bull trout populations (as listed in the 2002 recovery plan—the 2015 recovery plan lists the number of local populations in each recovery unit but does not note where those populations are located). Juvenile bull trout have been observed in one stream in the MFJDR core area that was not identified as a patch and has not been surveyed to determine if a bull trout population is present. With that possible exception and two patches where bull trout occupancy is unknown, our current understanding of the number and locations of bull trout populations in the MFJDR core area appears accurate.

In the NFJDR and upper JDR core areas, twenty-one patches were identified in which bull trout populations are not known to exist. In any of these patches that have not been rigorously surveyed, in addition to the three streams in the MFJDR core area where bull trout occupancy remains unknown, managers should consider sampling in the future to solidify our understanding of the number and locations of bull trout populations in the three core areas in the John Day River Basin.

Information on the life histories and migratory patterns of bull trout from the NFJDR and MFJDR core areas is largely lacking, and while such information is available for bull trout in the upper JDR core area, it is somewhat dated, having been collected fifteen or more years ago (Hemmingsen et al. 2001a, 2001b, 2001c, 2001d). Given the apparent low abundance of migratory bull trout in the NFJDR and MFJDR core areas, studying their seasonal distribution and movements may not be possible in the near future. Studies in those core areas as well as the upper JDR core area could be warranted farther into the future to evaluate the effects of recovery actions. In addition, while there are no demographic criteria for de-listing, information on demographic characteristics such as the distribution of bull trout and connectivity between local populations will be essential in determining whether the primary threats to bull trout have been addressed.

Information on bull trout population abundance and trend will also be required to determine if primary threats have been addressed. There has not been a basin-wide bull trout monitoring program in the John Day River Basin since 2004, and that program was designed to provide abundance estimates (redd counts) at the basin, not population, scale. The limited abundance data that exist for the NFJDR, MFJDR, and upper JDR core areas suggest bull trout abundance is low and possibly declining in each of those core areas. Given funding limitations, it will not be possible to extensively monitor all of the bull trout local population in the John Day River Basin. However, it may be possible to design and implement a scaled-down monitoring program that provides a balance of rigor (statistical and methodological), frequency, and cost. With respect to frequency, for example, depressed populations experiencing multiple or severe threats might be monitored more frequently than relatively healthy populations experiencing few or less severe threats. Other considerations would include, but not be limited to, the nature and location of past monitoring efforts and ongoing monitoring programs or research activities directed at other species that might provide useful information for assessing bull trout population abundance and trend. We recommend that managers explore the possibility of designing and implementing such a scaled-down monitoring program.

The quality of habitat for both subadult and adult bull trout and all of their strategies or activities in the NFJDR generally was rated as high or good during the colder months of the year (October – May) and as high, good, or fair (decreasing with increasing distance from the headwaters) during the warmer months of the year (June – September). There are no fish passage barriers in the NFJDR (Sankovich and Anglin 2014); thus, as has been reported previously, the production of migratory bull trout is not limited by an inability of migratory individuals to move freely throughout the main-stem, at least during the colder months of the year when there are no thermal barriers to movement (Sankovich and Anglin 2014). During the warmer months of the year, bull trout are limited to cold headwater areas in the NFJDR core area (with the exception of any cold water refuges downstream) and this restriction to their movement and distribution could be limiting the abundance of migratory individuals. Restoration efforts that increase the amount of cold water habitat available to bull trout in the NFJDR during the warmer months of the year should be given high priority.

In the MFJDR, the quality of habitat for both subadult and adult bull trout and all of their strategies or activities generally was rated as high or good during the colder months of the year and as good or fair during the warmer months of the year. Like the NFJDR, the MFJDR contains

no fish passage barriers (one possible barrier was observed in 2012 [Sankovich and Anglin 2014], but it was subsequently determined to be passable [J. Neal, ODFW retired, personal communication]), and thermal barriers that restrict migratory bull trout to headwater reaches may be limiting the production of migratory individuals. Also as in the NFJDR, restoration efforts that increase the amount of cold water habitat available to bull trout during the warmer months of the year should be given high priority.

In the upper JDR, habitat quality from JD3 upstream (e.g., upstream of the irrigation withdrawals) generally was rated as high or good throughout the year for both subadult and adult bull trout and all of their strategies or activities. Downstream from JD3, habitat quality generally was rated as high or good during the colder months of the year and fair or low during the warmer months of the year for both subadult and adult bull trout and all of their strategies or activities. As noted in the Methods, habitat quality in reaches with push up and lay flat stanchion dams was rated as fair in August – November due to uncertainties in passage conditions at those structures. If some or all of those dams impeded fish passage, habitat quality could have been lower than the model results indicated. Based on results from a radio telemetry study (Hemmingsen et al. 2001b) and on the incidental capture of bull trout in a screw trap at rkm 326 in the John Day River (e.g., Wilson et al. 2007), it is evident some bull trout from local populations in the upper JDR use the stream section containing the irrigation structures in the JDR. Because stream temperatures in the irrigated section of the JDR are unsuitable for bull trout in late summer, any impacts from passage impediments would likely occur to subadult and adult bull trout migrating downstream in fall. To the extent possible, managers should take steps to ensure lay flat stanchion dams are properly maintained. In addition, managers should continue to replace push up dams with structures that provide fish passage. Because cold water habitat is limited in the JDR in summer, as in the NFJDR and MFJDR, restoration efforts aimed at increasing the amount of cold water habitat should be given high priority.

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Appendix A, Table 1. Name, identification number, and area of bull trout patches in the John Day River Basin.

Patch name	Patch ID number	Patch area (ha)
Big Creek	1	15674.1
North Trail Creek	2	1537.7
South Trail Creek	3	2243.1
North Fork John Day River	4	4349.5
Baldy Creek (NFJD)	5	2569.2
Onion Creek (NFJD)	6	593.8
Crane Creek	7	904.9
Boulder Creek	8	474.5
East Fork Boundary Creek	9	403.4
Junkens Creek	10	662.1
Indian Creek	11	556.2
Big Creek	12	2123.6
South Fork Desolation Creek	13	2268.2
North Fork Desolation Creek	14	1161.3
Lake Creek	15	1419.2
Lost Creek	16	965.3
Wolesy Creek	17	559.5
Clear Creek (NFJD)	18	1661.3
Lightning Creek	19	1012.0
Granite Boulder Cr	20	1728.8
Badger Creek	21	589.3
Clear Creek (MFJD)	22	4336.7
Reynolds Creek	23	6266.7
Deardorff Creek	24	4779.8
Rail Creek	25	1929.0
Upper John Day River	26	4513.7
Roberts Creek	27	2224.1
Graham Creek	28	429.6
Slide Creek	29	825.4
Strawberry Creek	30	1091.6
Onion Creek (upper JD)	31	498.3
Indian Creek (upper JD)	32	2714.2
Middle Fork Canyon Creek	33	576.9
Pine Creek	34	642.2
Norton Fork	35	444.7
Dean Creek	36	403.7
Rock Creek	37	539.8
Baldy Creek (upper JD)	38	630.2
Bridge Creek	39	787.5
Lonesome Creek	40	527.7

Appendix B, Table 1. Up- and downstream boundaries, length, and coordinates of the downstream boundary of stream reaches in the North Fork John Day River where bull trout habitat quality was assessed.

Reach	Boundaries		Length (km)	Downstream boundary coordinates (UTM)	
	Upstream	Downstream		Easting	Northing
NF1	Headwaters	Cunningham Creek	6.0	399957	4973908
NF2	Cunningham Creek	Baldy Creek	4.9	395982	4973784
NF3	Baldy Creek	Trail Creek	8.6	388943	4974541
NF4	Trail Creek	Granite Creek	21.6	376565	4969229
NF5	Granite Creek	Big Creek	17.4	367264	4979904
NF6	Big Creek	Desolation Creek	25.9	347316	4984544
NF7	Desolation Creek	Camas Creek	5.6	342721	4986004
NF8	Camas Creek	Middle Fork John Day River	39.8	318310	4976182
NF9	Middle Fork John Day River	east end of Monument	24.3	309875	4966250
NF10	east end of Monument	Cottonwood Creek	2.0	308612	4965222
NF11	Cottonwood Creek	Mouth	25.4	290982	4959149

Appendix B, Table 2. Up- and downstream boundaries, length, and coordinates of the downstream boundary of reaches in the Middle Fork John Day River where bull trout habitat quality was assessed.






Reach	Boundaries		Length (km)	Downstream boundary coordinates (UTM)	
	Upstream	Downstream		Easting	Northing
MF1	Headwaters	downstream end of Phipps Meadows	2.6	385306	4937870
MF2	downstream end of Phipps Meadow	Highway 7	4.9	382314	4940016
MF3	Highway 7	Clear Creek	2.9	380404	4938909
MF4	Clear Creek	Vinegar Creek	2.7	378134	4939804
MF5	Vinegar Creek	Deerhorn Creek	5.9	374496	4942458
MF6	Deerhorn Creek	Granite Boulder Creek	7.8	368250	4944625
MF7	Granite Boulder Creek	Big Boulder Creek	6.7	363920	4947298
MF8	Big Boulder Creek	Camp Creek	8.3	357577	4950469
MF9	Camp Creek	upstream end of mine tailings	3.2	356040	4952263
MF10	upstream end of mine tailings	downstream end of mine tailings	3.6	354480	4954738
MF11	downstream end of mine tailings	Big Creek	7.8	351618	4958631
MF12	Big Creek	Long Creek	53.9	324374	4972890
MF13	Long Creek	Mouth	9.2	323468	4976195

Appendix B, Table 3. Up- and downstream boundaries, length, and coordinates of the downstream boundary of reaches in the John Day River where bull trout habitat quality was assessed.






Reach	Boundaries		Length (km)	Downstream boundary coordinates (UTM)	
	Upstream	Downstream		Easting	Northing
JD1	Headwaters	Call Creek	9.3	375752	4908592
JD2	Call Creek	Blue Mountain Hot Springs	4.6	374431	4912489
JD3	Blue Mountain Hot Springs	Jacobs Old Settlers Ditch	9.9	371408	4920207
JD4	Jacobs Old Settlers Ditch	unidentified ditch	1.8	370530	4921544
JD5	unidentified ditch	unidentified ditch	0.9	369985	4922106
JD6	unidentified ditch	Mill Ditch	2.9	367969	4923409
JD7	Mill Ditch	Ricco John Day River Ditch	9.6	359928	4922555
JD8	Ricco John Day River Ditch	Indian Creek	6.0	354540	4922100
JD9	Indian Creek	unidentified ditch	0.3	354259	4922118
JD10	unidentified ditch	Trowbridge Ditch	9.0	346872	4919912
JD11	Trowbridge Ditch	Canyon Creek	3.1	344049	4920648
JD12	Canyon Creek	Laycock Long Ditch	3.4	340857	4921059
JD13	Laycock Long Ditch	Enterprise Ditch	1.1	339509	4920763
JD14	Enterprise Ditch	unidentified ditch	3.4	336402	4920191
JD15	unidentified ditch	Loop Ranch pump station	0.8	335682	4920095
JD16	Loop Ranch pump station	Fry-Ingle Ditch	0.3	335356	4920024
JD17	Fry-Ingle Ditch	unidentified ditch	4.3	331436	4919695
JD18	unidentified ditch	Blue Mountain Ditch	1.0	330538	4919694
JD19	Blue Mountain Ditch	Mason and Damon Ditch	2.4	328472	4920572
JD20	Mason and Damon Ditch	unidentified ditch	3.4	326002	4920789
JD21	unidentified ditch	unnamed pump station	1.8	324605	4920525
JD22	unnamed pump station	unidentified ditch	0.8	323916	4920629

JD23	unidentified ditch	Boyce Ditch	2.9	321499	4921013
JD24	Boyce Ditch	Chandler Ditch	3.0	319234	4921677
JD25	Chandler Ditch	Moore Ditch	2.9	317600	4922889
JD26	Moore Ditch	Cummings River Ditch	2.5	315675	4922855
JD27	Cummings River Ditch	Dovenberg pump station	3.3	312966	4923155
JD28	Dovenberg pump station	Long Box Ditch	7.5	306997	4925259
JD29	Long Box Ditch	Auxier pump station	5.2	303478	4926235
JD30	Auxier pump station	unnamed pump station	3.7	301037	4926598
JD31	unnamed pump station	Throop Snyder Ditch	1.2	299930	4926547
JD32	Throop Snyder Ditch	South Fork John Day River	1.9	298601	4927494
JD33	South Fork John Day River	Clausen pump station	2.1	296927	4928470
JD34	Clausen pump station	Murray Ditch	0.7	296823	4929110
JD35	Murray Ditch	Kennedy Ditch	1.8	295233	4929619
JD36	Kennedy Ditch	unnamed pump station	2.8	293193	4930997
JD37	unnamed pump station	south end of Picture Gorge	2.3	291519	4932040
JD38	south end of Picture Gorge	north end of Picture Gorge	2.2	290744	4933922
JD39	north end of Picture Gorge	south end of Longview Ranch	14.7	290383	4945645
JD40	south end of Longview Ranch	unnamed pump station	12.2	290337	4955772
JD41	unnamed pump station	North Fork John Day River	4.8	290989	4959135






Appendix C, Table 1. Monthly habitat quality scores and indices for bull trout spawning habit in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.17	4.17	4.17	4.17	4.17	3.70	3.70	3.70	3.70	4.48	4.22	4.17	High 
NF2	4.34	4.34	4.34	4.34	4.34	3.87	3.87	3.87	3.87	4.13	4.39	4.34	
NF3	4.39	4.39	4.39	4.39	4.39	3.92	3.92	3.92	3.92	4.18	4.44	4.39	
NF4	4.24	4.24	4.24	4.24	4.24	3.51	3.51	3.51	3.51	3.77	4.29	4.24	Good 
NF5	4.21	4.21	4.21	4.21	4.21	3.23	3.23	3.23	3.23	3.23	4.01	4.21	
NF6	4.21	4.21	4.21	4.21	4.21	3.23	3.23	3.23	3.23	3.23	4.01	4.21	
NF7	4.13	4.13	4.13	4.13	4.13	3.15	3.15	3.15	3.15	3.15	3.93	4.13	Fair 
NF8	4.20	4.20	4.20	4.20	4.20	3.22	3.22	3.22	3.22	3.22	4.00	4.20	
NF9	4.12	4.12	4.12	4.12	4.12	3.15	3.15	3.15	3.15	3.15	3.93	4.12	
NF10	3.94	3.94	3.94	3.94	3.94	2.96	2.96	2.96	2.96	2.96	3.74	3.94	Low 
NF11	4.02	4.02	4.02	4.02	4.02	3.04	2.83	2.83	2.93	3.04	3.82	4.02	
													Poor 






Appendix C, Table 2. Monthly habitat scores and indices for bull trout spawning habit in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.00	4.00	4.00	4.00	4.00	2.00	2.00	2.00	2.00	5.00	4.00	4.00	High 
NF2	4.00	4.00	4.00	4.00	4.00	2.00	2.00	2.00	2.00	3.00	4.00	4.00	
NF3	4.00	4.00	4.00	4.00	4.00	2.00	2.00	2.00	2.00	3.00	4.00	4.00	
NF4	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00	2.00	4.00	4.00	Good 
NF5	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	
NF6	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	
NF7	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	Fair 
NF8	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	
NF9	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	
NF10	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	Low 
NF11	4.00	4.00	4.00	4.00	4.00	1.00	1.00	1.00	1.00	1.00	4.00	4.00	
													Poor 






Appendix C, Table 3. Monthly habitat quality scores and indices for juvenile rearing, foraging and growth habitat in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.15	4.15	4.15	4.15	4.15	4.48	4.48	4.19	4.48	3.90	4.19	4.15	High 
NF2	4.37	4.37	4.37	4.37	4.37	4.41	4.41	4.41	4.70	4.41	4.41	4.37	
NF3	4.42	4.42	4.42	4.42	4.42	4.46	4.46	4.75	4.46	4.46	4.46	4.42	
NF4	4.25	4.25	4.25	4.25	4.25	3.71	3.71	4.00	3.71	4.29	4.29	4.25	Good 
NF5	4.19	4.19	4.19	4.19	4.19	3.45	3.16	3.45	3.16	3.74	4.03	4.19	
NF6	4.19	4.19	4.19	4.19	4.19	3.16	3.16	3.16	3.16	3.74	4.03	4.19	
NF7	4.05	4.05	4.05	4.05	4.05	3.02	3.02	3.02	3.02	3.31	3.89	4.05	Fair 
NF8	4.20	4.20	4.20	4.20	4.20	3.17	3.17	3.17	3.17	3.46	4.04	4.20	
NF9	4.07	4.07	4.07	4.07	4.07	3.04	3.04	3.04	3.04	3.33	3.91	4.07	
NF10	3.80	3.80	3.80	3.80	3.80	2.77	2.77	2.77	2.77	2.77	3.64	3.80	Low 
NF11	3.93	3.93	3.93	3.93	3.93	2.91	2.81	2.81	2.86	2.91	3.77	3.93	
													Poor 






Appendix C, Table 4. Monthly habitat quality scores and indices for fluvial adult upstream migration habitat in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.43	4.43	4.43	4.43	4.43	4.47	4.47	4.47	4.12	4.12	4.47	4.43	High 
NF2	4.55	4.55	4.55	4.55	4.55	4.60	4.60	4.77	4.60	4.24	4.60	4.55	
NF3	4.60	4.60	4.60	4.60	4.60	4.82	4.82	4.64	4.64	4.29	4.64	4.60	
NF4	4.56	4.56	4.56	4.56	4.56	4.42	4.42	4.42	4.25	4.60	4.60	4.56	Good 
NF5	4.54	4.54	4.54	4.54	4.54	4.02	4.02	4.02	4.02	4.20	4.37	4.54	
NF6	4.54	4.54	4.54	4.54	4.54	4.02	4.02	4.02	4.02	4.20	4.37	4.54	
NF7	4.50	4.50	4.50	4.50	4.50	3.98	3.98	3.98	3.98	4.16	4.33	4.50	Fair 
NF8	4.54	4.54	4.54	4.54	4.54	3.85	3.85	4.02	3.85	4.02	4.38	4.54	
NF9	4.50	4.50	4.50	4.50	4.50	3.80	3.80	3.80	3.80	3.98	4.34	4.50	
NF10	4.35	4.35	4.35	4.35	4.35	3.65	3.65	3.65	3.65	3.83	4.18	4.35	Low 
NF11	4.39	4.39	4.39	4.39	4.39	3.69	3.31	3.31	3.50	3.87	4.22	4.39	
													Poor 






Appendix C, Table 5. Monthly habitat quality scores and indices for adult foraging and maintenance habitat in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.21	4.21	4.21	4.21	4.21	4.23	4.23	4.23	4.23	3.98	4.23	4.21	High 
NF2	4.38	4.38	4.38	4.38	4.38	4.40	4.40	4.66	4.40	4.40	4.40	4.38	
NF3	4.42	4.42	4.42	4.42	4.42	4.70	4.70	4.45	4.45	4.45	4.45	4.42	
NF4	4.35	4.35	4.35	4.35	4.35	4.12	4.12	4.37	3.87	4.37	4.37	4.35	Good 
NF5	4.30	4.30	4.30	4.30	4.30	3.68	3.68	3.68	3.68	4.19	4.19	4.30	
NF6	4.30	4.30	4.30	4.30	4.30	3.68	3.68	3.68	3.68	4.19	4.19	4.30	
NF7	4.18	4.18	4.18	4.18	4.18	3.57	3.57	3.57	3.57	3.82	4.07	4.18	Fair 
NF8	4.32	4.32	4.32	4.32	4.32	3.45	3.45	3.70	3.45	3.70	4.21	4.32	
NF9	4.20	4.20	4.20	4.20	4.20	3.33	3.33	3.33	3.33	3.59	4.09	4.20	
NF10	3.93	3.93	3.93	3.93	3.93	3.06	3.06	3.06	3.06	3.32	3.82	3.93	Low 
NF11	4.05	4.05	4.05	4.05	4.05	3.18	3.02	3.02	3.10	3.43	3.94	4.05	
													Poor 






Appendix C, Table 6. Monthly habitat quality scores and indices for fluvial adult downstream migration habitat in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.37	4.37	4.37	4.37	4.37	4.40	4.40	4.40	4.40	4.40	4.40	4.37	High 
NF2	4.49	4.49	4.49	4.49	4.49	4.52	4.52	4.52	4.52	4.72	4.52	4.49	
NF3	4.51	4.51	4.51	4.51	4.51	4.55	4.55	4.55	4.55	4.75	4.55	4.51	
NF4	4.50	4.50	4.50	4.50	4.50	4.33	4.33	4.33	4.13	4.53	4.53	4.50	Good 
NF5	4.46	4.46	4.46	4.46	4.46	3.92	3.92	3.92	3.92	4.12	4.32	4.46	
NF6	4.46	4.46	4.46	4.46	4.46	3.92	3.92	3.92	3.92	4.12	4.32	4.46	
NF7	4.40	4.40	4.40	4.40	4.40	3.86	3.86	3.86	3.86	4.06	4.26	4.40	Fair 
NF8	4.45	4.45	4.45	4.45	4.45	3.71	3.71	3.91	3.71	3.91	4.31	4.45	
NF9	4.39	4.39	4.39	4.39	4.39	3.65	3.65	3.65	3.65	3.85	4.25	4.39	
NF10	4.20	4.20	4.20	4.20	4.20	3.47	3.47	3.47	3.47	3.67	4.07	4.20	Low 
NF11	4.26	4.26	4.26	4.26	4.26	3.52	3.36	3.36	3.52	3.72	4.12	4.26	
													Poor 






Appendix C, Table 7. Monthly habitat quality scores and indices subadult downstream migration habitat in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.35	4.35	4.35	4.35	4.35	4.38	4.38	4.38	4.38	4.38	4.38	4.35	High 
NF2	4.47	4.47	4.47	4.47	4.47	4.50	4.50	4.50	4.50	4.74	4.50	4.47	
NF3	4.50	4.50	4.50	4.50	4.50	4.53	4.53	4.53	4.53	4.77	4.53	4.50	
NF4	4.48	4.48	4.48	4.48	4.48	4.27	4.27	4.27	4.03	4.51	4.51	4.48	Good 
NF5	4.45	4.45	4.45	4.45	4.45	3.84	3.84	3.84	3.84	4.08	4.32	4.45	
NF6	4.45	4.45	4.45	4.45	4.45	3.84	3.84	3.84	3.84	4.08	4.32	4.45	
NF7	4.39	4.39	4.39	4.39	4.39	3.78	3.78	3.78	3.78	4.02	4.26	4.39	Fair 
NF8	4.45	4.45	4.45	4.45	4.45	3.60	3.60	3.84	3.60	3.84	4.31	4.45	
NF9	4.39	4.39	4.39	4.39	4.39	3.54	3.54	3.54	3.54	3.78	4.25	4.39	
NF10	4.21	4.21	4.21	4.21	4.21	3.36	3.36	3.36	3.36	3.60	4.08	4.21	Low 
NF11	4.27	4.27	4.27	4.27	4.27	3.42	3.25	3.25	3.42	3.66	4.14	4.27	
													Poor 






Appendix C, Table 8. Monthly habitat quality scores and indices for fluvial subadult upstream migration habitat in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.43	4.43	4.43	4.43	4.43	4.67	4.67	4.67	4.67	4.67	4.47	4.43	High 
NF2	4.55	4.55	4.55	4.55	4.55	4.79	4.79	4.79	4.79	4.79	4.59	4.55	
NF3	4.59	4.59	4.59	4.59	4.59	4.83	4.83	4.83	4.83	4.83	4.63	4.59	
NF4	4.51	4.51	4.51	4.51	4.51	4.35	4.35	4.55	4.15	4.75	4.55	4.51	Good 
NF5	4.50	4.50	4.50	4.50	4.50	3.94	3.94	3.94	3.94	4.34	4.34	4.50	
NF6	4.50	4.50	4.50	4.50	4.50	3.94	3.94	3.94	3.94	4.34	4.34	4.50	
NF7	4.45	4.45	4.45	4.45	4.45	3.90	3.90	3.90	3.90	4.10	4.29	4.45	Fair 
NF8	4.45	4.45	4.45	4.45	4.45	3.90	3.90	3.90	3.90	4.10	4.29	4.45	
NF9	4.45	4.45	4.45	4.45	4.45	3.70	3.70	3.70	3.70	3.90	4.29	4.45	
NF10	4.28	4.28	4.28	4.28	4.28	3.53	3.53	3.53	3.53	3.73	4.13	4.28	Low 
NF11	4.33	4.33	4.33	4.33	4.33	3.24	3.24	3.24	3.40	3.77	4.17	4.33	
													Poor 






Appendix C, Table 9. Monthly habitat quality scores and indices for fluvial subadult rearing, foraging, and growth habitat in eleven reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
NF1	4.19	4.19	4.19	4.19	4.19	4.22	4.22	4.22	4.22	3.69	4.22	4.19	High 
NF2	4.34	4.34	4.34	4.34	4.34	4.37	4.37	4.64	4.37	4.11	4.37	4.34	
NF3	4.38	4.38	4.38	4.38	4.38	4.67	4.67	4.40	4.40	4.14	4.40	4.38	
NF4	4.32	4.32	4.32	4.32	4.32	4.08	4.08	4.34	3.81	4.34	4.34	4.32	Good 
NF5	4.27	4.27	4.27	4.27	4.27	3.62	3.62	3.62	3.62	4.15	4.15	4.27	
NF6	4.27	4.27	4.27	4.27	4.27	3.62	3.62	3.62	3.62	4.15	4.15	4.27	
NF7	4.17	4.17	4.17	4.17	4.17	3.52	3.52	3.52	3.52	3.79	4.06	4.17	Fair 
NF8	4.27	4.27	4.27	4.27	4.27	3.36	3.36	3.63	3.36	3.63	4.16	4.27	
NF9	4.17	4.17	4.17	4.17	4.17	3.26	3.26	3.26	3.26	3.53	4.06	4.17	
NF10	3.94	3.94	3.94	3.94	3.94	3.03	3.03	3.03	3.03	3.30	3.83	3.94	Low 
NF11	4.04	4.04	4.04	4.04	4.04	3.13	2.98	2.98	3.06	3.39	3.92	4.04	
													Poor 






Appendix D, Table 1. Monthly habitat quality scores and indices for bull trout spawning habit in thirteen reaches in the Middle Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
MF1	4.52	4.26	4.52	4.00	3.74	3.28	3.28	2.85	3.28	3.54	3.54	4.26	High 
MF2	4.57	4.31	4.57	4.05	3.79	3.58	3.36	3.15	3.36	3.84	4.10	4.31	
MF3	4.43	4.17	4.43	3.91	3.39	3.19	2.98	2.76	2.98	3.45	3.71	4.17	
MF4	4.13	4.13	4.39	4.13	3.61	3.15	2.94	2.72	2.94	3.41	4.19	4.13	Good 
MF5	4.10	4.10	4.36	4.10	3.58	3.12	2.91	2.69	3.17	3.64	3.90	4.10	
MF6	4.21	4.21	4.21	3.95	3.69	3.23	3.02	2.80	3.02	3.75	4.27	4.21	
MF7	4.21	4.21	4.21	4.47	3.69	3.49	3.02	2.80	3.02	3.49	3.75	4.21	Fair 
MF8	4.17	4.17	4.17	3.91	3.65	3.20	2.98	2.76	2.98	3.71	3.97	4.17	
MF9	4.16	4.16	4.42	3.90	3.64	3.69	3.22	3.00	3.22	3.69	4.21	4.16	
MF10	4.02	4.02	4.02	3.76	3.50	3.04	2.82	2.61	2.82	3.30	3.82	4.11	Low 
MF11	4.21	4.21	4.21	3.95	3.69	3.23	3.02	2.80	3.02	3.49	4.01	4.21	
MF12	4.21	4.21	4.21	3.95	3.69	3.23	3.02	2.80	3.02	3.75	4.27	4.21	
MF13	4.12	4.12	4.12	3.60	3.60	3.15	2.93	2.71	2.93	3.41	3.93	4.12	Poor 






Appendix D, Table 2. Monthly habitat quality scores and indices for juvenile rearing, foraging and growth habitat in thirteen reaches in the Middle Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
MF1	3.88	3.88	3.88	4.17	4.17	3.14	3.43	3.00	3.43	4.01	4.01	3.59	High 
MF2	4.00	4.00	4.00	4.29	4.29	3.75	3.24	3.32	3.82	4.62	4.33	3.71	
MF3	3.78	3.78	3.78	4.07	3.78	3.33	2.83	2.90	3.41	4.20	3.91	3.49	
MF4	3.44	3.73	3.73	3.44	4.01	3.28	2.77	2.85	3.35	4.14	3.85	3.44	Good 
MF5	3.45	3.74	3.74	3.45	4.03	3.29	2.79	2.86	3.66	3.87	3.58	3.45	
MF6	3.63	3.63	3.63	4.21	4.50	3.76	2.96	3.04	3.54	4.05	3.76	3.63	
MF7	3.63	3.63	3.63	3.92	4.50	4.05	3.25	3.04	3.54	4.34	4.05	3.63	Fair 
MF8	3.57	3.57	3.57	4.15	4.15	3.70	2.91	2.69	3.49	3.99	3.70	3.57	
MF9	3.59	3.59	3.88	4.17	4.46	4.21	3.12	2.91	3.70	4.50	3.92	3.59	
MF10	3.38	3.67	3.67	3.96	4.24	3.51	2.71	2.50	3.00	4.08	3.51	3.49	Low 
MF11	3.63	3.92	3.92	4.21	4.21	3.76	2.96	2.75	3.25	4.34	3.76	3.51	
MF12	3.63	3.63	3.63	4.21	4.50	3.76	2.96	2.75	3.54	4.05	3.76	3.63	
MF13	3.49	3.49	3.49	4.07	4.07	3.62	2.82	2.61	3.11	4.20	3.62	3.49	Poor 






Appendix D, Table 3. Monthly habitat quality scores and indices for fluvial adult upstream migration habitat in thirteen reaches in the Middle Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
MF1	4.15	3.97	4.15	4.15	4.68	3.98	3.98	3.43	4.16	4.51	4.34	3.97	High 
MF2	4.20	4.03	4.20	4.20	4.73	4.25	3.97	3.69	4.15	4.60	4.25	4.03	
MF3	4.09	3.92	4.09	4.09	4.27	3.93	3.65	3.37	3.83	4.28	3.93	3.92	
MF4	3.89	3.89	4.06	3.89	4.42	4.07	3.62	3.34	3.80	4.25	3.90	3.89	Good 
MF5	3.92	3.92	4.09	3.92	4.45	4.10	3.65	3.37	4.18	3.93	3.75	3.92	
MF6	4.00	4.00	4.00	4.18	4.53	4.19	3.73	3.46	3.91	4.01	4.01	4.00	
MF7	4.00	4.00	4.00	4.18	4.18	4.54	3.73	3.46	3.91	4.36	4.01	4.00	Fair 
MF8	3.97	3.97	3.97	4.15	4.50	4.16	3.70	3.43	3.88	3.98	3.80	3.97	
MF9	3.96	3.96	4.13	4.13	4.49	4.71	3.90	3.62	4.08	4.18	4.00	3.96	
MF10	3.55	3.55	3.55	3.72	4.08	3.73	3.28	3.00	3.46	3.56	3.38	3.88	Low 
MF11	4.00	4.00	4.00	4.18	4.53	4.19	3.73	3.46	3.91	4.36	3.83	3.66	
MF12	4.00	4.00	4.00	4.18	4.53	4.19	3.73	3.46	3.91	4.01	4.01	4.00	
MF13	3.97	3.97	3.97	4.50	4.50	4.16	3.71	3.43	3.88	3.98	3.80	3.97	Poor 






Appendix D, Table 4. Monthly habitat quality scores and indices for adult foraging and maintenance habitat in thirteen reaches in the Middle Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
MF1	3.91	3.91	3.91	4.17	4.42	3.55	3.55	3.11	3.80	4.31	4.05	3.66	High 
MF2	4.06	4.06	4.06	4.31	4.56	3.83	3.61	3.39	4.12	4.34	4.34	3.80	
MF3	3.84	3.84	3.84	4.09	4.09	3.47	3.25	3.03	3.76	3.98	3.98	3.58	
MF4	3.53	3.79	3.79	3.53	4.04	3.67	3.20	2.98	3.71	3.93	3.93	3.53	Good 
MF5	3.62	3.87	3.87	3.62	4.12	3.76	3.29	3.06	4.05	4.01	3.76	3.62	
MF6	3.79	3.79	3.79	4.29	4.29	4.18	3.45	3.23	3.96	4.18	3.93	3.79	
MF7	3.79	3.79	3.79	4.04	4.29	4.43	3.45	3.23	3.96	4.18	4.18	3.79	Fair 
MF8	3.74	3.74	3.74	4.24	4.24	4.13	3.40	3.18	3.91	4.13	3.88	3.74	
MF9	3.76	3.76	4.01	4.26	4.26	4.55	3.56	3.34	4.07	4.29	4.04	3.76	
MF10	3.38	3.64	3.64	3.89	3.89	3.78	3.05	2.83	3.30	3.78	3.52	3.63	Low 
MF11	3.79	4.04	4.04	4.29	4.29	4.18	3.45	3.23	3.71	4.18	3.93	3.54	
MF12	3.79	3.79	3.79	4.29	4.29	4.18	3.45	3.23	3.96	4.18	3.93	3.79	
MF13	3.70	3.70	3.70	4.20	4.20	4.09	3.37	3.14	3.62	4.09	3.84	3.70	Poor 






Appendix D, Table 5. Monthly habitat quality scores and indices for fluvial adult downstream migration habitat in thirteen reaches in the Middle Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
MF1	4.37	4.37	4.37	4.57	4.37	3.83	3.83	3.30	4.03	4.23	4.23	3.97	High 
MF2	4.46	4.46	4.46	4.66	4.46	4.09	3.83	3.56	4.03	4.49	4.69	4.06	
MF3	4.29	4.29	4.29	4.49	4.09	3.76	3.49	3.23	3.69	4.16	4.36	3.89	
MF4	3.86	4.26	4.26	3.86	4.26	3.93	3.46	3.20	3.66	4.13	4.33	3.86	Good 
MF5	3.93	4.33	4.33	3.93	4.33	4.00	3.53	3.27	3.93	4.40	4.20	3.93	
MF6	4.04	4.04	4.04	4.64	4.44	4.10	3.64	3.38	3.84	4.50	4.30	4.04	
MF7	4.04	4.04	4.04	4.44	4.44	4.30	3.64	3.38	3.84	4.30	4.50	4.04	Fair 
MF8	4.01	4.01	4.01	4.61	4.41	4.07	3.61	3.35	3.81	4.47	4.27	4.01	
MF9	4.00	4.00	4.40	4.61	4.40	4.44	3.78	3.51	3.98	4.44	4.44	4.00	
MF10	3.64	4.04	4.04	4.24	4.04	3.70	3.24	2.98	3.44	3.90	3.90	3.91	Low 
MF11	4.04	4.44	4.44	4.64	4.44	4.10	3.64	3.38	3.84	4.30	4.30	3.77	
MF12	4.04	4.04	4.04	4.64	4.44	4.10	3.64	3.38	3.84	4.50	4.30	4.04	
MF13	3.99	3.99	3.99	4.39	4.39	4.05	3.59	3.33	3.79	4.25	4.25	3.99	Poor 






Appendix D, Table 6. Monthly habitat quality scores and indices subadult downstream migration habitat in thirteen reaches in the North Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
MF1	4.35	4.35	4.35	4.59	4.35	3.74	3.74	3.32	3.98	4.22	4.22	3.87	High 
MF2	4.44	4.44	4.44	4.68	4.44	4.00	3.79	3.57	4.02	4.47	4.71	3.96	
MF3	4.29	4.29	4.29	4.53	4.05	3.68	3.47	3.26	3.71	4.16	4.40	3.81	
MF4	3.79	4.26	4.26	3.79	4.26	3.89	3.44	3.23	3.68	4.13	4.37	3.79	Good 
MF5	3.85	4.33	4.33	3.85	4.33	3.95	3.50	3.29	3.98	4.43	4.19	3.85	
MF6	3.95	3.95	3.95	4.67	4.43	4.06	3.61	3.40	3.85	4.54	4.30	3.95	
MF7	3.95	3.95	3.95	4.43	4.43	4.30	3.61	3.40	3.85	4.30	4.54	3.95	Fair 
MF8	3.93	3.93	3.93	4.64	4.40	4.03	3.58	3.37	3.82	4.51	4.27	3.93	
MF9	3.92	3.92	4.40	4.64	4.40	4.43	3.74	3.53	3.98	4.43	4.43	3.92	
MF10	3.50	3.97	3.97	4.21	3.97	3.60	3.15	2.94	3.39	3.84	3.84	3.83	Low 
MF11	3.95	4.43	4.43	4.67	4.43	4.06	3.61	3.40	3.85	4.30	4.30	3.62	
MF12	3.95	3.95	3.95	4.67	4.43	4.06	3.61	3.40	3.85	4.54	4.30	3.95	
MF13	3.91	3.91	3.91	4.39	4.39	4.02	3.57	3.35	3.80	4.25	4.25	3.91	Poor 






Appendix D, Table 7. Monthly habitat quality scores and indices for fluvial subadult upstream migration habitat in thirteen reaches in the Middle Fork John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
MF1	4.67	4.67	4.67	4.67	4.67	3.92	3.92	3.37	4.12	4.52	4.52	4.67	High 
MF2	4.75	4.75	4.75	4.75	4.75	4.19	3.92	3.64	4.32	4.79	4.79	4.75	
MF3	4.62	4.62	4.62	4.62	4.42	3.86	3.59	3.32	3.99	4.46	4.46	4.62	
MF4	4.59	4.59	4.59	4.59	4.59	4.04	3.56	3.29	3.96	4.43	4.43	4.59	Good 
MF5	4.58	4.58	4.58	4.58	4.58	4.02	3.55	3.28	4.15	4.42	4.42	4.58	
MF6	4.67	4.67	4.67	4.67	4.67	4.32	3.64	3.37	4.04	4.52	4.52	4.67	
MF7	4.67	4.67	4.67	4.67	4.67	4.52	3.64	3.37	4.04	4.52	4.52	4.67	Fair 
MF8	4.67	4.67	4.67	4.67	4.67	4.52	3.64	3.37	4.04	4.52	4.52	4.67	
MF9	4.63	4.63	4.63	4.63	4.63	4.67	3.80	3.53	4.20	4.67	4.67	4.63	
MF10	4.26	4.26	4.26	4.26	4.26	3.90	3.23	2.96	3.43	4.10	4.10	4.55	Low 
MF11	4.67	4.67	4.67	4.67	4.67	4.32	3.64	3.37	3.84	4.52	4.52	4.38	
MF12	4.67	4.67	4.67	4.67	4.67	4.32	3.64	3.37	4.04	4.52	4.52	4.67	
MF13	4.65	4.65	4.65	4.65	4.65	4.29	3.62	3.35	3.82	4.49	4.49	4.65	Poor 

Appendix D, Table 8. Monthly habitat quality scores and indices for fluvial subadult rearing, foraging, and growth habitat in thirteen reaches in the Middle Fork John Day River.






	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
MF1	3.62	3.62	3.62	3.89	4.42	3.51	3.51	3.09	3.77	4.30	4.04	3.62	High 
MF2	3.75	3.75	3.75	4.01	4.54	3.78	3.57	3.36	4.10	4.31	4.04	3.75	
MF3	3.55	3.55	3.55	3.81	4.08	3.43	3.22	3.02	3.75	3.96	3.70	3.55	
MF4	3.51	3.51	3.51	3.51	4.04	3.66	3.18	2.98	3.71	3.92	3.66	3.51	Good 
MF5	3.58	3.58	3.58	3.58	4.11	3.73	3.26	3.05	4.06	3.73	3.47	3.58	
MF6	3.73	3.73	3.73	3.99	4.26	4.15	3.41	3.20	3.94	3.88	3.61	3.73	
MF7	3.73	3.73	3.73	3.73	4.26	4.41	3.41	3.20	3.94	4.15	3.88	3.73	Fair 
MF8	3.69	3.69	3.69	3.95	4.22	4.10	3.37	3.16	3.90	3.84	3.57	3.69	
MF9	3.70	3.70	3.70	3.97	4.23	4.53	3.52	3.31	4.05	4.26	3.73	3.70	
MF10	3.31	3.31	3.31	3.57	3.84	3.72	2.98	2.77	3.25	3.72	3.19	3.59	Low 
MF11	3.73	3.73	3.73	3.99	4.26	4.15	3.41	3.20	3.67	4.15	3.61	3.44	
MF12	3.73	3.73	3.73	3.99	4.26	4.15	3.41	3.20	3.94	3.88	3.61	3.73	
MF13	3.64	3.64	3.64	4.17	4.17	4.06	3.32	3.11	3.59	4.06	3.53	3.64	Poor 

Appendix E, Table 1. Monthly habitat quality scores and indices for bull trout spawning habit in forty-one reaches in the John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
JD1	4.22	4.22	4.22	4.22	4.22	3.75	3.49	3.49	3.75	3.75	4.27	4.22	High 
JD2	4.17	4.17	4.17	4.17	4.17	3.44	3.44	3.44	3.70	3.70	4.22	4.17	
JD3	4.06	4.06	4.06	4.06	4.06	3.09	2.87	2.87	2.87	3.13	3.86	4.06	
JD4	3.93	3.93	3.50	3.50	3.50	2.77	2.56	2.56	2.56	2.82	3.98	3.93	Good 
JD5	4.07	4.07	4.07	3.64	3.64	2.66	2.45	2.45	2.45	2.71	3.87	4.07	
JD6	4.07	4.07	3.64	3.64	3.64	2.66	2.45	2.45	2.45	2.45	3.87	4.07	
JD7	3.98	3.98	3.98	3.55	3.55	2.82	2.61	2.61	2.61	2.61	4.03	3.98	Fair 
JD8	4.03	4.03	3.60	3.60	3.60	2.62	2.62	2.62	2.62	2.62	3.83	4.03	
JD9	3.91	3.91	3.91	3.48	3.48	2.75	2.54	2.54	2.54	2.54	3.96	3.91	
JD10	4.03	4.03	3.60	3.60	3.60	2.62	2.41	2.41	2.41	2.41	3.83	4.03	Low 
JD11	3.89	3.89	3.89	3.46	3.46	2.48	2.48	2.48	2.48	2.48	3.69	3.89	
JD12	3.84	3.84	3.41	3.41	3.41	2.68	2.47	2.47	2.47	2.47	3.89	3.84	
JD13	3.98	3.98	3.98	3.55	3.55	2.82	2.61	2.61	2.61	2.61	4.03	3.98	Poor 
JD14	4.03	4.03	3.60	3.60	3.60	2.62	2.41	2.41	2.41	2.41	3.83	4.03	
JD15	4.03	4.03	4.03	3.60	3.60	2.62	2.41	2.41	2.41	2.41	3.83	4.03	
JD16	4.03	4.03	3.60	3.60	3.60	2.62	2.41	2.41	2.41	2.41	3.83	4.03	
JD17	4.03	4.03	4.03	3.60	3.60	2.62	2.41	2.41	2.41	2.41	3.83	4.03	
JD18	4.03	4.03	3.60	3.60	3.60	2.62	2.41	2.41	2.41	2.41	3.83	4.03	
JD19	3.93	3.93	3.93	3.50	3.50	2.77	2.56	2.56	2.56	2.56	3.98	3.93	
JD20	4.03	4.03	3.59	3.59	3.59	2.62	2.40	2.40	2.40	2.40	3.83	4.03	
JD21	3.99	3.99	3.99	3.56	3.56	2.58	2.37	2.37	2.37	2.37	3.79	3.99	
JD22	3.89	3.89	3.45	3.45	3.45	2.48	2.26	2.26	2.26	2.26	3.69	3.89	
JD23	3.99	3.99	3.99	3.56	3.56	2.58	2.37	2.37	2.37	2.37	3.79	3.99	
JD24	3.99	3.99	3.56	3.56	3.56	2.58	2.37	2.37	2.37	2.37	3.79	3.99	
JD25	4.03	4.03	4.03	3.59	3.59	2.62	2.40	2.40	2.40	2.40	3.83	4.03	






JD26	3.93	3.93	3.50	3.50	3.50	2.77	2.55	2.55	2.55	2.55	3.98	3.93
JD27	4.03	4.03	4.03	3.59	3.59	2.62	2.40	2.40	2.40	2.40	3.83	4.03
JD28	3.99	3.99	3.56	3.56	3.56	2.58	2.37	2.37	2.37	2.37	3.79	3.99
JD29	3.98	3.98	3.98	3.54	3.54	2.82	2.60	2.60	2.60	2.60	4.03	3.98
JD30	4.03	4.03	3.59	3.59	3.59	2.62	2.40	2.40	2.40	2.40	3.83	4.03
JD31	3.99	3.99	3.99	3.56	3.56	2.58	2.37	2.37	2.37	2.37	3.79	3.99
JD32	4.03	4.03	3.59	3.59	3.59	2.62	2.62	2.62	2.62	2.62	3.83	4.03
JD33	3.99	3.99	3.99	3.56	3.56	2.58	2.37	2.37	2.37	2.37	3.79	3.99
JD34	4.03	4.03	3.59	3.59	3.59	2.62	2.40	2.40	2.40	2.40	3.83	4.03
JD35	3.99	3.99	3.99	3.56	3.56	2.58	2.37	2.37	2.37	2.37	3.79	3.99
JD36	3.99	3.99	3.56	3.56	3.56	2.58	2.37	2.37	2.37	2.37	3.79	3.99
JD37	3.99	3.99	3.99	3.56	3.56	2.58	2.58	2.58	2.58	2.58	3.79	3.99
JD38	3.73	3.73	3.30	3.30	3.30	2.32	2.32	2.32	2.32	2.32	3.53	3.73
JD39	4.03	4.03	4.03	3.59	3.59	2.62	2.62	2.62	2.62	2.62	3.83	4.03
JD40	3.93	3.93	3.49	3.49	3.49	2.41	2.41	2.41	3.19	3.19	3.73	3.93
JD41	4.03	4.03	4.03	3.59	3.59	2.62	2.62	2.62	3.40	3.40	3.83	4.03

Appendix E, Table 2. Monthly habitat quality scores and indices for juvenile rearing, foraging and growth habitat in forty-one reaches in the John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
JD1	4.19	4.19	4.19	4.19	4.19	4.23	3.94	3.94	4.23	4.52	4.23	4.19	High 
JD2	4.15	4.15	4.15	4.15	4.15	3.90	3.90	3.90	4.19	4.48	4.19	4.15	
JD3	3.97	3.97	3.97	3.97	3.97	3.24	3.14	3.14	3.43	3.72	3.81	3.97	
JD4	3.86	3.86	3.43	3.43	3.43	2.89	2.79	2.79	2.50	3.37	3.90	3.86	Good 
JD5	3.99	3.99	3.99	3.56	3.56	2.82	2.73	2.44	2.73	3.30	3.83	3.99	
JD6	3.99	3.99	3.56	3.56	3.56	2.53	2.44	2.44	2.73	3.02	3.83	3.99	
JD7	3.90	3.90	3.90	3.47	3.47	2.64	2.54	2.54	2.54	2.83	3.94	3.90	Fair 
JD8	3.94	3.94	3.51	3.51	3.51	2.48	2.48	2.48	2.48	2.77	3.78	3.94	
JD9	3.91	3.91	3.91	3.48	3.48	2.66	2.56	2.56	2.56	2.85	3.95	3.91	
JD10	3.94	3.94	3.51	3.51	3.51	2.48	2.38	2.38	2.38	2.67	3.78	3.94	Low 
JD11	3.72	3.72	3.72	3.29	3.29	2.26	2.26	2.26	2.26	2.55	3.56	3.72	
JD12	3.68	3.68	3.25	3.25	3.25	2.42	2.33	2.33	2.33	2.62	3.72	3.68	
JD13	3.90	3.90	3.90	3.47	3.47	2.64	2.54	2.54	2.54	2.83	3.94	3.90	Poor 
JD14	3.94	3.94	3.51	3.51	3.51	2.48	2.38	2.38	2.38	2.67	3.78	3.94	
JD15	3.94	3.94	3.94	3.51	3.51	2.48	2.38	2.38	2.38	2.67	3.78	3.94	
JD16	3.94	3.94	3.51	3.51	3.51	2.48	2.38	2.38	2.38	2.67	3.78	3.94	
JD17	3.94	3.94	3.94	3.51	3.51	2.48	2.38	2.38	2.38	2.67	3.78	3.94	
JD18	3.94	3.94	3.51	3.51	3.51	2.48	2.38	2.38	2.38	2.67	3.78	3.94	
JD19	3.86	3.86	3.86	3.43	3.43	2.60	2.50	2.50	2.50	2.79	3.90	3.86	
JD20	3.95	3.95	3.52	3.52	3.52	2.49	2.39	2.39	2.39	2.68	3.79	3.95	
JD21	3.89	3.89	3.89	3.47	3.47	2.44	2.34	2.34	2.34	2.63	3.73	3.89	
JD22	3.83	3.83	3.41	3.41	3.41	2.38	2.28	2.28	2.28	2.57	3.67	3.83	
JD23	3.89	3.89	3.89	3.47	3.47	2.44	2.34	2.34	2.34	2.63	3.73	3.89	
JD24	3.89	3.89	3.47	3.47	3.47	2.44	2.34	2.34	2.34	2.63	3.73	3.89	
JD25	3.95	3.95	3.95	3.52	3.52	2.49	2.39	2.39	2.39	2.68	3.79	3.95	






JD26	3.87	3.87	3.44	3.44	3.44	2.61	2.52	2.52	2.52	2.80	3.91	3.87
JD27	3.95	3.95	3.95	3.52	3.52	2.49	2.39	2.39	2.39	2.68	3.79	3.95
JD28	3.89	3.89	3.47	3.47	3.47	2.44	2.34	2.34	2.34	2.63	3.73	3.89
JD29	3.91	3.91	3.91	3.48	3.48	2.65	2.56	2.56	2.56	2.84	3.95	3.91
JD30	3.95	3.95	3.52	3.52	3.52	2.49	2.39	2.39	2.39	2.68	3.79	3.95
JD31	3.89	3.89	3.89	3.47	3.47	2.44	2.34	2.34	2.34	2.63	3.73	3.89
JD32	3.95	3.95	3.52	3.52	3.52	2.49	2.49	2.49	2.49	2.78	3.79	3.95
JD33	3.89	3.89	3.89	3.47	3.47	2.44	2.34	2.34	2.34	2.63	3.73	3.89
JD34	3.95	3.95	3.52	3.52	3.52	2.49	2.39	2.39	2.39	2.68	3.79	3.95
JD35	3.89	3.89	3.89	3.47	3.47	2.44	2.34	2.34	2.34	2.63	3.73	3.89
JD36	3.89	3.89	3.47	3.47	3.47	2.44	2.34	2.34	2.34	2.63	3.73	3.89
JD37	3.89	3.89	3.89	3.47	3.47	2.44	2.44	2.44	2.44	2.73	3.73	3.89
JD38	3.62	3.62	3.19	3.19	3.19	2.16	2.16	2.16	2.16	2.16	3.46	3.62
JD39	3.95	3.95	3.95	3.52	3.52	2.49	2.49	2.49	2.49	2.49	3.79	3.95
JD40	3.95	3.95	3.52	3.52	3.52	2.44	3.02	2.44	2.73	2.73	3.79	3.95
JD41	3.95	3.95	3.95	3.52	3.52	2.49	3.07	2.49	2.78	2.78	3.79	3.95

Appendix E, Table 3. Monthly habitat quality scores and indices for fluvial adult upstream migration habitat in forty-one reaches in the John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
JD1	4.44	4.44	4.44	4.44	4.44	4.66	4.30	4.30	4.66	4.13	4.48	4.44	High 
JD2	4.41	4.41	4.41	4.41	4.41	4.28	4.28	4.28	4.63	4.10	4.45	4.41	
JD3	4.42	4.42	4.42	4.42	4.42	4.07	3.69	3.52	3.69	3.87	4.25	4.42	
JD4	4.22	4.22	3.67	3.67	3.67	3.53	3.15	2.98	2.80	3.33	4.26	4.22	Good 
JD5	4.33	4.33	4.33	3.78	3.78	3.26	2.88	2.88	3.06	3.41	4.17	4.33	
JD6	4.33	4.33	3.78	3.78	3.78	3.26	2.88	2.88	2.88	3.06	4.17	4.33	
JD7	4.26	4.26	4.26	3.71	3.71	3.40	3.02	3.02	3.02	3.20	4.30	4.26	Fair 
JD8	4.30	4.30	3.75	3.75	3.75	3.23	3.23	3.23	3.23	3.41	4.14	4.30	
JD9	4.18	4.18	4.18	3.62	3.62	3.31	2.93	2.93	2.93	3.11	4.22	4.18	
JD10	4.30	4.30	3.75	3.75	3.75	3.23	2.85	2.67	2.85	3.03	4.14	4.30	Low 
JD11	4.11	4.11	4.11	3.56	3.56	3.03	3.03	2.86	3.03	3.21	3.94	4.11	
JD12	4.07	4.07	3.51	3.51	3.51	3.20	2.82	2.65	2.82	3.00	4.11	4.07	
JD13	4.26	4.26	4.26	3.71	3.71	3.40	3.02	2.84	3.02	3.20	4.30	4.26	Poor 
JD14	4.30	4.30	3.75	3.75	3.75	3.23	2.85	2.67	2.85	3.03	4.14	4.30	
JD15	4.30	4.30	4.30	3.75	3.75	3.23	2.85	2.67	2.85	3.03	4.14	4.30	
JD16	4.30	4.30	3.75	3.75	3.75	3.23	2.85	2.67	2.85	3.03	4.14	4.30	
JD17	4.30	4.30	4.30	3.75	3.75	3.23	2.85	2.67	2.85	3.03	4.14	4.30	
JD18	4.30	4.30	3.75	3.75	3.75	3.23	2.85	2.67	2.85	3.03	4.14	4.30	
JD19	4.22	4.22	4.22	3.67	3.67	3.36	2.98	2.80	2.98	3.15	4.26	4.22	
JD20	4.31	4.31	3.75	3.75	3.75	3.23	2.68	2.68	2.85	3.03	4.14	4.31	
JD21	4.28	4.28	4.28	3.72	3.72	3.20	2.82	2.65	2.82	3.00	4.11	4.28	
JD22	4.23	4.23	3.67	3.67	3.67	3.15	2.60	2.60	2.77	2.95	4.06	4.23	
JD23	4.28	4.28	4.28	3.72	3.72	3.20	2.65	2.65	2.82	2.82	4.11	4.28	
JD24	4.28	4.28	3.72	3.72	3.72	3.20	2.65	2.65	2.82	2.82	4.11	4.28	
JD25	4.31	4.31	4.31	3.75	3.75	3.06	2.68	2.68	2.85	2.85	4.14	4.31	






JD26	4.22	4.22	3.67	3.67	3.67	3.18	2.80	2.80	2.98	2.98	4.26	4.22
JD27	4.31	4.31	4.31	3.75	3.75	3.06	2.68	2.68	2.85	2.85	4.14	4.31
JD28	4.28	4.28	3.72	3.72	3.72	3.03	2.65	2.65	2.82	2.82	4.11	4.28
JD29	4.26	4.26	4.26	3.71	3.71	3.22	2.84	2.84	3.02	3.02	4.31	4.26
JD30	4.31	4.31	3.75	3.75	3.75	3.06	2.68	2.68	2.85	2.85	4.14	4.31
JD31	4.28	4.28	4.28	3.72	3.72	3.03	2.65	2.65	2.82	2.82	4.11	4.28
JD32	4.31	4.31	3.75	3.75	3.75	3.06	3.06	3.06	3.23	3.23	4.14	4.31
JD33	4.28	4.28	4.28	3.72	3.72	3.03	2.65	2.65	2.82	2.82	4.11	4.28
JD34	4.31	4.31	3.75	3.75	3.75	3.06	2.68	2.68	2.85	2.85	4.14	4.31
JD35	4.28	4.28	4.28	3.72	3.72	3.03	2.65	2.65	2.82	2.82	4.11	4.28
JD36	4.28	4.28	3.72	3.72	3.72	3.03	2.65	2.65	2.82	2.82	4.11	4.28
JD37	4.28	4.28	4.28	3.72	3.72	3.03	3.03	3.03	3.20	3.20	4.11	4.28
JD38	4.19	4.19	3.64	3.64	3.64	2.94	2.94	2.94	2.94	3.12	4.03	4.19
JD39	4.31	4.31	4.31	3.75	3.75	3.06	3.06	3.06	3.06	3.23	4.14	4.31
JD40	4.31	4.31	3.75	3.75	3.75	2.87	2.87	2.87	2.87	2.87	4.14	4.31
JD41	4.31	4.31	4.31	3.75	3.75	3.06	3.06	3.06	3.06	3.06	4.14	4.31

Appendix E, Table 4. Monthly habitat quality scores and indices for adult foraging and maintenance habitat in forty-one reaches in the John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
JD1	4.23	4.23	4.23	4.23	4.23	4.51	4.26	4.26	4.51	4.26	4.26	4.23	High 
JD2	4.21	4.21	4.21	4.21	4.21	4.23	4.23	4.23	4.49	4.23	4.23	4.21	
JD3	4.07	4.07	4.07	4.07	4.07	3.71	3.55	3.30	3.80	3.80	3.96	4.07	
JD4	3.94	3.94	3.49	3.49	3.49	3.27	3.11	2.86	2.60	3.36	3.96	3.94	Good 
JD5	4.04	4.04	4.04	3.60	3.60	2.98	2.82	2.82	3.08	3.58	3.93	4.04	
JD6	4.04	4.04	3.60	3.60	3.60	2.98	2.82	2.82	2.82	3.33	3.93	4.04	
JD7	3.96	3.96	3.96	3.52	3.52	3.04	2.88	2.88	2.88	3.14	3.99	3.96	Fair 
JD8	3.99	3.99	3.55	3.55	3.55	2.93	2.93	2.93	2.93	3.19	3.88	3.99	
JD9	4.00	4.00	4.00	3.55	3.55	3.08	2.92	2.92	2.92	3.17	4.02	4.00	
JD10	3.99	3.99	3.55	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	Low 
JD11	3.74	3.74	3.74	3.30	3.30	2.68	2.68	2.43	2.68	2.94	3.63	3.74	
JD12	3.71	3.71	3.27	3.27	3.27	2.79	2.63	2.38	2.63	2.89	3.74	3.71	
JD13	3.96	3.96	3.96	3.52	3.52	3.04	2.88	2.63	2.88	3.14	3.99	3.96	Poor 
JD14	3.99	3.99	3.55	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD15	3.99	3.99	3.99	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD16	3.99	3.99	3.55	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD17	3.99	3.99	3.99	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD18	3.99	3.99	3.55	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD19	3.94	3.94	3.94	3.49	3.49	3.02	2.86	2.60	2.86	3.11	3.96	3.94	
JD20	4.01	4.01	3.57	3.57	3.57	2.95	2.54	2.54	2.79	3.05	3.90	4.01	
JD21	3.96	3.96	3.96	3.52	3.52	2.91	2.75	2.49	2.75	3.00	3.85	3.96	
JD22	3.91	3.91	3.47	3.47	3.47	2.85	2.44	2.44	2.69	2.94	3.80	3.91	
JD23	3.96	3.96	3.96	3.52	3.52	2.91	2.49	2.49	2.75	2.75	3.85	3.96	
JD24	3.96	3.96	3.52	3.52	3.52	2.91	2.49	2.49	2.75	2.75	3.85	3.96	
JD25	4.01	4.01	4.01	3.57	3.57	2.70	2.54	2.54	2.79	2.79	3.90	4.01	






JD26	3.96	3.96	3.52	3.52	3.52	2.78	2.63	2.63	2.88	2.88	3.99	3.96
JD27	4.01	4.01	4.01	3.57	3.57	2.70	2.54	2.54	2.79	2.79	3.90	4.01
JD28	3.96	3.96	3.52	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD29	3.99	3.99	3.99	3.54	3.54	2.81	2.65	2.65	2.91	2.91	4.01	3.99
JD30	4.01	4.01	3.57	3.57	3.57	2.70	2.54	2.54	2.79	2.79	3.90	4.01
JD31	3.96	3.96	3.96	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD32	4.01	4.01	3.57	3.57	3.57	2.70	2.70	2.70	2.95	2.95	3.90	4.01
JD33	3.96	3.96	3.96	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD34	4.01	4.01	3.57	3.57	3.57	2.70	2.54	2.54	2.79	2.79	3.90	4.01
JD35	3.96	3.96	3.96	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD36	3.96	3.96	3.52	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD37	3.96	3.96	3.96	3.52	3.52	2.65	2.65	2.65	2.91	2.91	3.85	3.96
JD38	3.74	3.74	3.29	3.29	3.29	2.42	2.42	2.42	2.42	2.68	3.63	3.74
JD39	4.01	4.01	4.01	3.57	3.57	2.70	2.70	2.70	2.70	2.95	3.90	4.01
JD40	4.01	4.01	3.57	3.57	3.57	2.62	2.62	2.62	2.87	2.87	3.90	4.01
JD41	4.01	4.01	4.01	3.57	3.57	2.70	2.70	2.70	2.95	2.95	3.90	4.01

Appendix E, Table 5. Monthly habitat quality scores and indices for fluvial adult downstream migration habitat in forty-one reaches in the John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
JD1	4.40	4.40	4.40	4.40	4.40	4.43	4.23	4.23	4.43	4.43	4.43	4.40	High 
JD2	4.36	4.21	4.21	4.21	4.21	4.23	4.23	4.23	4.49	4.23	4.23	4.21	
JD3	4.30	4.07	4.07	4.07	4.07	3.71	3.55	3.30	3.80	3.80	3.96	4.07	
JD4	4.14	3.94	3.49	3.49	3.49	3.27	3.11	2.86	2.60	3.36	3.96	3.94	Good 
JD5	4.24	4.04	4.04	3.60	3.60	2.98	2.82	2.82	3.08	3.58	3.93	4.04	
JD6	4.24	4.04	3.60	3.60	3.60	2.98	2.82	2.82	2.82	3.33	3.93	4.04	
JD7	4.18	3.96	3.96	3.52	3.52	3.04	2.88	2.88	2.88	3.14	3.99	3.96	Fair 
JD8	4.21	3.99	3.55	3.55	3.55	2.93	2.93	2.93	2.93	3.19	3.88	3.99	
JD9	4.13	4.00	4.00	3.55	3.55	3.08	2.92	2.92	2.92	3.17	4.02	4.00	
JD10	4.21	3.99	3.55	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	Low 
JD11	4.02	3.74	3.74	3.30	3.30	2.68	2.68	2.43	2.68	2.94	3.63	3.74	
JD12	3.98	3.71	3.27	3.27	3.27	2.79	2.63	2.38	2.63	2.89	3.74	3.71	
JD13	4.18	3.96	3.96	3.52	3.52	3.04	2.88	2.63	2.88	3.14	3.99	3.96	Poor 
JD14	4.21	3.99	3.55	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD15	4.21	3.99	3.99	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD16	4.21	3.99	3.55	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD17	4.21	3.99	3.99	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD18	4.21	3.99	3.55	3.55	3.55	2.93	2.77	2.52	2.77	3.03	3.88	3.99	
JD19	4.14	3.94	3.94	3.49	3.49	3.02	2.86	2.60	2.86	3.11	3.96	3.94	
JD20	4.20	4.01	3.57	3.57	3.57	2.95	2.54	2.54	2.79	3.05	3.90	4.01	
JD21	4.17	3.96	3.96	3.52	3.52	2.91	2.75	2.49	2.75	3.00	3.85	3.96	
JD22	4.11	3.91	3.47	3.47	3.47	2.85	2.44	2.44	2.69	2.94	3.80	3.91	
JD23	4.17	3.96	3.96	3.52	3.52	2.91	2.49	2.49	2.75	2.75	3.85	3.96	
JD24	4.17	3.96	3.52	3.52	3.52	2.91	2.49	2.49	2.75	2.75	3.85	3.96	
JD25	4.20	4.01	4.01	3.57	3.57	2.70	2.54	2.54	2.79	2.79	3.90	4.01	






JD26	4.13	3.96	3.52	3.52	3.52	2.78	2.63	2.63	2.88	2.88	3.99	3.96
JD27	4.20	4.01	4.01	3.57	3.57	2.70	2.54	2.54	2.79	2.79	3.90	4.01
JD28	4.17	3.96	3.52	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD29	4.17	3.99	3.99	3.54	3.54	2.81	2.65	2.65	2.91	2.91	4.01	3.99
JD30	4.20	4.01	3.57	3.57	3.57	2.70	2.54	2.54	2.79	2.79	3.90	4.01
JD31	4.17	3.96	3.96	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD32	4.20	4.01	3.57	3.57	3.57	2.70	2.70	2.70	2.95	2.95	3.90	4.01
JD33	4.17	3.96	3.96	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD34	4.20	4.01	3.57	3.57	3.57	2.70	2.54	2.54	2.79	2.79	3.90	4.01
JD35	4.17	3.96	3.96	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD36	4.17	3.96	3.52	3.52	3.52	2.65	2.49	2.49	2.75	2.75	3.85	3.96
JD37	4.17	3.96	3.96	3.52	3.52	2.65	2.65	2.65	2.91	2.91	3.85	3.96
JD38	4.06	3.74	3.29	3.29	3.29	2.42	2.42	2.42	2.42	2.68	3.63	3.74
JD39	4.20	4.01	4.01	3.57	3.57	2.70	2.70	2.70	2.70	2.95	3.90	4.01
JD40	4.20	4.01	3.57	3.57	3.57	2.62	2.62	2.62	2.87	2.87	3.90	4.01
JD41	4.20	4.01	4.01	3.57	3.57	2.70	2.70	2.70	2.95	2.95	3.90	4.01

Appendix E, Table 6. Monthly habitat quality scores and indices subadult downstream migration habitat in forty-one reaches in the John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
JD1	4.38	4.38	4.38	4.38	4.38	4.41	4.17	4.17	4.41	4.41	4.41	4.38	High 
JD2	4.35	4.35	4.35	4.35	4.35	4.14	4.14	4.14	4.38	4.38	4.38	4.35	
JD3	4.30	4.30	4.30	4.30	4.30	3.93	3.58	3.34	3.58	3.82	4.17	4.30	
JD4	4.12	4.12	3.70	3.70	3.70	3.49	3.15	2.91	2.67	3.38	4.15	4.12	Good 
JD5	4.21	4.21	4.21	3.79	3.79	3.18	2.84	2.84	3.07	3.31	4.08	4.21	
JD6	4.21	4.21	3.79	3.79	3.79	3.18	2.84	2.84	2.84	3.07	4.08	4.21	
JD7	4.15	4.15	4.15	3.73	3.73	3.29	2.94	2.94	2.94	3.18	4.19	4.15	Fair 
JD8	4.19	4.19	3.76	3.76	3.76	3.15	3.15	3.15	3.15	3.39	4.05	4.19	
JD9	4.11	4.11	4.11	3.69	3.69	3.25	2.90	2.90	2.90	3.14	4.15	4.11	
JD10	4.19	4.19	3.76	3.76	3.76	3.15	2.81	2.57	2.81	3.05	4.05	4.19	Low 
JD11	3.97	3.97	3.97	3.54	3.54	2.94	2.94	2.70	2.94	3.17	3.84	3.97	
JD12	3.93	3.93	3.51	3.51	3.51	3.07	2.72	2.48	2.72	2.96	3.97	3.93	
JD13	4.15	4.15	4.15	3.73	3.73	3.29	2.94	2.70	2.94	3.18	4.19	4.15	Poor 
JD14	4.19	4.19	3.76	3.76	3.76	3.15	2.81	2.57	2.81	3.05	4.05	4.19	
JD15	4.19	4.19	4.19	3.76	3.76	3.15	2.81	2.57	2.81	3.05	4.05	4.19	
JD16	4.19	4.19	3.76	3.76	3.76	3.15	2.81	2.57	2.81	3.05	4.05	4.19	
JD17	4.19	4.19	4.19	3.76	3.76	3.15	2.81	2.57	2.81	3.05	4.05	4.19	
JD18	4.19	4.19	3.76	3.76	3.76	3.15	2.81	2.57	2.81	3.05	4.05	4.19	
JD19	4.12	4.12	4.12	3.70	3.70	3.25	2.91	2.67	2.91	3.15	4.15	4.12	
JD20	4.18	4.18	3.76	3.76	3.76	3.15	2.57	2.57	2.80	3.04	4.05	4.18	
JD21	4.15	4.15	4.15	3.73	3.73	3.12	2.78	2.54	2.78	3.02	4.02	4.15	
JD22	4.10	4.10	3.68	3.68	3.68	3.07	2.49	2.49	2.73	2.96	3.97	4.10	
JD23	4.15	4.15	4.15	3.73	3.73	3.12	2.54	2.54	2.78	2.78	4.02	4.15	
JD24	4.15	4.15	3.73	3.73	3.73	3.12	2.54	2.54	2.78	2.78	4.02	4.15	
JD25	4.18	4.18	4.18	3.76	3.76	2.91	2.57	2.57	2.80	2.80	4.05	4.18	






JD26	4.12	4.12	3.69	3.69	3.69	3.01	2.66	2.66	2.90	2.90	4.15	4.12
JD27	4.18	4.18	4.18	3.76	3.76	2.91	2.57	2.57	2.80	2.80	4.05	4.18
JD28	4.15	4.15	3.73	3.73	3.73	2.88	2.54	2.54	2.78	2.78	4.02	4.15
JD29	4.15	4.15	4.15	3.73	3.73	3.04	2.70	2.70	2.94	2.94	4.18	4.15
JD30	4.18	4.18	3.76	3.76	3.76	2.91	2.57	2.57	2.80	2.80	4.05	4.18
JD31	4.15	4.15	4.15	3.73	3.73	2.88	2.54	2.54	2.78	2.78	4.02	4.15
JD32	4.18	4.18	3.76	3.76	3.76	2.91	2.91	2.91	3.15	3.15	4.05	4.18
JD33	4.15	4.15	4.15	3.73	3.73	2.88	2.54	2.54	2.78	2.78	4.02	4.15
JD34	4.18	4.18	3.76	3.76	3.76	2.91	2.57	2.57	2.80	2.80	4.05	4.18
JD35	4.15	4.15	4.15	3.73	3.73	2.88	2.54	2.54	2.78	2.78	4.02	4.15
JD36	4.15	4.15	3.73	3.73	3.73	2.88	2.54	2.54	2.78	2.78	4.02	4.15
JD37	4.15	4.15	4.15	3.73	3.73	2.88	2.88	2.88	3.12	3.12	4.02	4.15
JD38	4.04	4.04	3.61	3.61	3.61	2.77	2.77	2.77	2.77	3.00	3.90	4.04
JD39	4.18	4.18	4.18	3.76	3.76	2.91	2.91	2.91	2.91	3.15	4.05	4.18
JD40	4.18	4.18	3.76	3.76	3.76	2.74	2.74	2.74	2.98	2.98	4.05	4.18
JD41	4.18	4.18	4.18	3.76	3.76	2.91	2.91	2.91	3.15	3.15	4.05	4.18

Appendix E, Table 7. Monthly habitat quality scores and indices for fluvial subadult upstream migration habitat in forty-one reaches in the John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
JD1	4.47	4.47	4.47	4.47	4.47	4.71	4.51	4.51	4.71	4.71	4.51	4.47	High 
JD2	4.44	4.44	4.44	4.44	4.44	4.48	4.48	4.48	4.68	4.68	4.48	4.44	
JD3	4.35	4.35	4.35	4.35	4.35	4.00	3.66	3.46	3.86	4.06	4.20	4.35	
JD4	4.18	3.92	3.50	3.50	3.50	3.27	3.12	2.86	2.59	3.39	3.95	3.92	Good 
JD5	4.28	4.02	4.02	3.60	3.60	2.96	2.81	2.81	3.08	3.61	3.90	4.02	
JD6	4.28	4.02	3.60	3.60	3.60	2.96	2.81	2.81	2.81	3.34	3.90	4.02	
JD7	4.22	3.95	3.95	3.53	3.53	3.03	2.89	2.89	2.89	3.15	3.98	3.95	Fair 
JD8	4.26	3.98	3.56	3.56	3.56	2.92	2.92	2.92	2.92	3.18	3.86	3.98	
JD9	4.14	3.96	3.96	3.54	3.54	3.04	2.90	2.90	2.90	3.16	3.99	3.96	
JD10	4.26	3.98	3.56	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	Low 
JD11	4.07	3.74	3.74	3.32	3.32	2.68	2.68	2.41	2.68	2.94	3.62	3.74	
JD12	4.03	3.71	3.29	3.29	3.29	2.79	2.65	2.38	2.65	2.91	3.74	3.71	
JD13	4.22	3.95	3.95	3.53	3.53	3.03	2.89	2.62	2.89	3.15	3.98	3.95	Poor 
JD14	4.26	3.98	3.56	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD15	4.26	3.98	3.98	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD16	4.26	3.98	3.56	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD17	4.26	3.98	3.98	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD18	4.26	3.98	3.56	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD19	4.18	3.92	3.92	3.50	3.50	3.00	2.86	2.59	2.86	3.12	3.95	3.92	
JD20	4.26	3.98	3.57	3.57	3.57	2.92	2.51	2.51	2.78	3.04	3.87	3.98	
JD21	4.23	3.94	3.94	3.53	3.53	2.88	2.74	2.47	2.74	3.00	3.83	3.94	
JD22	4.17	3.89	3.47	3.47	3.47	2.82	2.42	2.42	2.68	2.95	3.77	3.89	
JD23	4.23	3.94	3.94	3.53	3.53	2.88	2.47	2.47	2.74	2.74	3.83	3.94	
JD24	4.23	3.94	3.53	3.53	3.53	2.88	2.47	2.47	2.74	2.74	3.83	3.94	
JD25	4.26	3.98	3.98	3.57	3.57	2.66	2.51	2.51	2.78	2.78	3.87	3.98	

JD26	4.18	3.92	3.51	3.51	3.51	2.74	2.60	2.60	2.86	2.86	3.95	3.92
JD27	4.26	3.98	3.98	3.57	3.57	2.66	2.51	2.51	2.78	2.78	3.87	3.98
JD28	4.23	3.94	3.53	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD29	4.22	3.95	3.95	3.54	3.54	2.77	2.63	2.63	2.89	2.89	3.98	3.95
JD30	4.26	3.98	3.57	3.57	3.57	2.66	2.51	2.51	2.78	2.78	3.87	3.98
JD31	4.23	3.94	3.94	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD32	4.26	3.98	3.57	3.57	3.57	2.66	2.66	2.66	2.92	2.92	3.87	3.98
JD33	4.23	3.94	3.94	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD34	4.26	3.98	3.57	3.57	3.57	2.66	2.51	2.51	2.78	2.78	3.87	3.98
JD35	4.23	3.94	3.94	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD36	4.23	3.94	3.53	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD37	4.23	3.94	3.94	3.53	3.53	2.61	2.61	2.61	2.88	2.88	3.83	3.94
JD38	4.14	3.75	3.33	3.33	3.33	2.42	2.42	2.42	2.42	2.69	3.63	3.75
JD39	4.26	3.98	3.98	3.57	3.57	2.66	2.66	2.66	2.66	2.92	3.87	3.98
JD40	4.26	3.98	3.57	3.57	3.57	2.58	2.58	2.58	2.85	2.85	3.87	3.98
JD41	4.26	3.98	3.98	3.57	3.57	2.66	2.66	2.66	2.92	2.92	3.87	3.98

Appendix E, Table 8. Monthly habitat quality scores and indices for fluvial subadult rearing, foraging, and growth habitat in forty-one reaches in the John Day River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	HQ Index
JD1	4.22	4.22	4.22	4.22	4.22	4.51	4.25	4.25	4.51	4.25	4.25	4.22	High 
JD2	4.18	4.18	4.18	4.18	4.18	4.21	4.21	4.21	4.47	4.21	4.21	4.18	
JD3	4.07	4.07	4.07	4.07	4.07	3.69	3.55	3.29	3.82	3.82	3.96	4.07	
JD4	3.92	3.92	3.50	3.50	3.50	3.27	3.12	2.86	2.59	3.39	3.95	3.92	Good 
JD5	4.02	4.02	4.02	3.60	3.60	2.96	2.81	2.81	3.08	3.61	3.90	4.02	
JD6	4.02	4.02	3.60	3.60	3.60	2.96	2.81	2.81	2.81	3.34	3.90	4.02	
JD7	3.95	3.95	3.95	3.53	3.53	3.03	2.89	2.89	2.89	3.15	3.98	3.95	Fair 
JD8	3.98	3.98	3.56	3.56	3.56	2.92	2.92	2.92	2.92	3.18	3.86	3.98	
JD9	3.96	3.96	3.96	3.54	3.54	3.04	2.90	2.90	2.90	3.16	3.99	3.96	
JD10	3.98	3.98	3.56	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	Low 
JD11	3.74	3.74	3.74	3.32	3.32	2.68	2.68	2.41	2.68	2.94	3.62	3.74	
JD12	3.71	3.71	3.29	3.29	3.29	2.79	2.65	2.38	2.65	2.91	3.74	3.71	
JD13	3.95	3.95	3.95	3.53	3.53	3.03	2.89	2.62	2.89	3.15	3.98	3.95	Poor 
JD14	3.98	3.98	3.56	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD15	3.98	3.98	3.98	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD16	3.98	3.98	3.56	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD17	3.98	3.98	3.98	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD18	3.98	3.98	3.56	3.56	3.56	2.92	2.77	2.51	2.77	3.04	3.86	3.98	
JD19	3.92	3.92	3.92	3.50	3.50	3.00	2.86	2.59	2.86	3.12	3.95	3.92	
JD20	3.98	3.98	3.57	3.57	3.57	2.92	2.51	2.51	2.78	3.04	3.87	3.98	
JD21	3.94	3.94	3.94	3.53	3.53	2.88	2.74	2.47	2.74	3.00	3.83	3.94	
JD22	3.89	3.89	3.47	3.47	3.47	2.82	2.42	2.42	2.68	2.95	3.77	3.89	
JD23	3.94	3.94	3.94	3.53	3.53	2.88	2.47	2.47	2.74	2.74	3.83	3.94	
JD24	3.94	3.94	3.53	3.53	3.53	2.88	2.47	2.47	2.74	2.74	3.83	3.94	
JD25	3.98	3.98	3.98	3.57	3.57	2.66	2.51	2.51	2.78	2.78	3.87	3.98	

JD26	3.92	3.92	3.51	3.51	3.51	2.74	2.60	2.60	2.86	2.86	3.95	3.92
JD27	3.98	3.98	3.98	3.57	3.57	2.66	2.51	2.51	2.78	2.78	3.87	3.98
JD28	3.94	3.94	3.53	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD29	3.95	3.95	3.95	3.54	3.54	2.77	2.63	2.63	2.89	2.89	3.98	3.95
JD30	3.98	3.98	3.57	3.57	3.57	2.66	2.51	2.51	2.78	2.78	3.87	3.98
JD31	3.94	3.94	3.94	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD32	3.98	3.98	3.57	3.57	3.57	2.66	2.66	2.66	2.92	2.92	3.87	3.98
JD33	3.94	3.94	3.94	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD34	3.98	3.98	3.57	3.57	3.57	2.66	2.51	2.51	2.78	2.78	3.87	3.98
JD35	3.94	3.94	3.94	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD36	3.94	3.94	3.53	3.53	3.53	2.61	2.47	2.47	2.74	2.74	3.83	3.94
JD37	3.94	3.94	3.94	3.53	3.53	2.61	2.61	2.61	2.88	2.88	3.83	3.94
JD38	3.75	3.75	3.33	3.33	3.33	2.42	2.42	2.42	2.42	2.69	3.63	3.75
JD39	3.98	3.98	3.98	3.57	3.57	2.66	2.66	2.66	2.66	2.92	3.87	3.98
JD40	3.98	3.98	3.57	3.57	3.57	2.58	2.58	2.58	2.85	2.85	3.87	3.98
JD41	3.98	3.98	3.98	3.57	3.57	2.66	2.66	2.66	2.92	2.92	3.87	3.98

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